Built environment – Core criteria for building safety in competence frameworks – Code of practice

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This BSI Flex

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Contents

Foreword

This BSI Flex was sponsored by the Ministry of Housing, Communities and Local Government (MHCLG). Its development was facilitated by BSI Standards Limited and it was released under licence from The British Standards Institution.

Acknowledgement is given to Richard Harral (Technical Director, CABE) as the technical author, individual contributors, including those responding to public consultations, and to the following organizations and their representatives, who contributed as members of the Advisory Group:

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- Build UK
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- Construction Products Association
- Electrical Contractors' Association
- Engineering Council
- Fire Sector Federation
- Health and Safety Executive
- Institute of Workplace and Facilities Management
- Local Authority Building Control
- Ministry of Housing, Communities and Local Government
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Acknowledgement is also given to the members of Working Group 0 and the Competence Steering Group (CSG) who have supported the development of this BSI Flex in earlier form and to all those who contributed to the Raising the Bar and Setting the Bar reports on which this BSI Flex draws.

This BSI Flex is not to be regarded as a British Standard. It will be withdrawn in the event of its being superseded by a PAS or a British Standard.

The agile BSI Flex development process enables a code of practice to be rapidly developed, on an iterative basis, in order to fulfil an immediate need in industry. A BSI Flex can be considered for further development as a PAS or British Standard, or constitute part of the UK input into the development of a European or International Standard.

Information about this document

This is a full revision of the BSI Flex, and introduces the following principal changes:

- the status has been changed from a specification to a code of practice;
- the title has been revised to more accurately reflect and communicate intended use;
- the introduction has been simplified and clarified;
- the scope has been simplified and clarified;
- additional defined terms have been introduced to improve clarity; and
- core competence and indicative competence have been retitled "core competence criteria" and "scope" to better reflect their use in mapping building safety criteria on to sector specific frameworks.

Use of this document

The provisions of this BSI Flex are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

It has been assumed in the preparation of this BSI Flex that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

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0 Introduction

0.1 Background

People have the right to expect that buildings and their immediate environment are designed, built, and maintained in a way that is safe. Occupants (including residents, workers, and visitors) need to have confidence and trust in the people responsible for ensuring that their interests are properly considered, and that safety is a priority. Competence of all who provide services and products throughout the life of a building is key to achieving this outcome.

This BSI Flex sets core building safety criteria for built environment competence frameworks. It is intended that the core criteria be contextualized within sector-specific frameworks to reflect the appropriate scope and level of competence required for an individual to undertake a defined role, function, activity, or task. Contextualization can be:

a) within sector-specific competence frameworks, e.g. to reflect differing seniority or responsibility; and/or

b) in relation to specific types of buildings or activities, e.g. higher-risk buildings or, for example, manufacturing of construction products.

Compliance with this BSI Flex can be achieved by mapping new or existing sector specific frameworks against the core competence criteria and scope, and explaining any divergence arising from the context within which the framework will be used (see **0.4**).

This BSI Flex is one part of a broader standards framework for competence of individuals in the built environment.

0.2 Objectives

This BSI Flex is intended to support wider industry reform with the ultimate objective of minimizing safety risks and improving protection to consumers and occupants, including residents, in and about buildings. There are three overarching objectives:

a) set core criteria for building safety competence, including fire safety, structural safety and public health for all individuals working in the built environment, to improve safety outcomes throughout the building lifecycle;

b) facilitate consistent and objective development, evaluation or use of sector-specific competence frameworks by certification, licensing, accrediting, qualifying, and validating bodies, regulators, clients and employers; and

c) support progressive development of a more consistent approach in the development and use of competence frameworks across the built environment.

This BSI Flex is also intended to meet the following specific objectives:

1) support development of a robust oversight, monitoring and feedback process for sector-specific competence frameworks;

2) support development of competence frameworks for key duty-holding or appointed roles in managing safety;

3) identify core building safety criteria that are likely to be common to all sector-specific competence frameworks;

4) support commonality and consistency in building safety competence across sector-specific frameworks; and

5) support individuals and organizations working in the built environment to move towards progressively adopting an approach based on validation and periodic revalidation.

0.3 Competence and competence frameworks

0.3.1 General

Competence-based assessment is widely adopted across most industries. However, the definition of competence, and how to assess it, can vary across, or even within, sectors. Competence is used as one part of a systemic approach to describing job roles and job specifications, interviewing candidates for employment or promotion, and managing performance. It is also commonly used to assess eligibility for qualification, membership, registration, certification or licensing in specific disciplines or roles.

It is common for legislation aimed at protecting people to set requirements for dutyholders to check the competence of individuals undertaking works. This BSI Flex enables this principle to be extended more broadly so that competence assessment also includes those whose work impacts on the safety of buildings.

Whilst oversight of competence might rest with professional, trade or training bodies, competence is ultimately an individual responsibility relevant to every person in the construction and built environment workforce. Embedding building safety competence at all levels and across all roles, functions, tasks and activities is critical in protecting residents and other occupants throughout the building lifecycle.

This BSI Flex is intended for use in the development and evaluation of sector-specific competence frameworks. It is not intended for use as a competence framework against which individuals can be directly assessed.

This BSI Flex sets out core criteria against which sector-specific competence frameworks can be developed or assessed in relation to building safety, including:

- core criteria for the information, structure, and procedural components of sector-specific competence frameworks;
- core behavioural criteria to support industry in the development of a stronger safety culture; and
- core competence criteria for building safety, which need to be identifiable within sector-specific competence frameworks where relevant to the role, function or task covered by that framework.

The majority of a typical building's life consists of being maintained or refurbished whilst in occupation, which means that managing building safety during this period is as important as during initial construction. As existing buildings significantly outnumber new construction projects, residual risks are mainly found in this existing stock. As a result, it is important that sector-specific frameworks are structured to maintain a balance of competence between new and existing buildings, including alterations, extensions, retrofit, renovation repair and maintenance, change of use or function and other work where relevant.

***NOTE** The core competence recommendations within this BSI Flex are to be interpreted in the context of the role, function, activities or task relevant to each sector-specific framework.*

0.3.2 Competence

Competence is defined in many different ways across different industries. This is necessary to reflect the specific circumstances and meet the specific needs of the individuals and organizations that employ individuals operating in those industries.

The work undertaken by individuals in the built environment is particularly diverse and encapsulates a wide range of roles including installers, trades, managers, construction professionals, finance, administration, procurement specialists and manufacturing disciplines.

In the context of this BSI Flex, for an individual to be considered competent means that they need to have the appropriate skills, knowledge and experience, combined with appropriate behaviours, to be able to fulfil their defined role, function or activity and carry out appropriate tasks. This is sometimes referred to in shorthand as SKEB.

Behavioural competence, when combined with existing skills, knowledge, and experience, helps to engender a sense of individual responsibility and accountability as part of an effective and strong safety culture.

An assessment of skills, knowledge, experience and behaviours explores whether an individual demonstrates general competences designed to anticipate the broad demands of particular roles, tasks or activities. Assessment cannot predict future circumstances and complexities or give complete assurance that an individual in the same role will always respond in the same way.

0.3.3 Validation and revalidation

Validation is the process by which an individual is assessed as being competent to fulfil a specific role. This might give access to qualification, registration, a licence to practice or the ability to work in a given role, and typically follows a period of monitored and supervised development.

Revalidation is a periodic reassessment or re-evaluation of competence which provides assurance that the necessary skills, knowledge, experience and behaviours have been maintained or developed such that the individual remains competent to fulfil the specified role. The process for revalidation needs to be proportionate, reasonable, effective and robust. Whilst validation and revalidation adds cost and takes time, ensuring that individuals remain competent adds value for both the individual and their business.

The time period between revalidations varies depending on a number of factors including (but not exclusively):

a) an assessment of risk relating to the role – the higher the risks, the more frequently revalidation might need to be undertaken;
b) the adequacy or otherwise of measures available to sustain and maintain competence; and
c) the rate of change of skills and knowledge relevant to the role – where good practice, contextual risks (including technology), regulatory requirements or duties are changing quickly, more frequent revalidation might be necessary.

Revalidation processes might also use a wider range of experiential evidence, including but not limited to training, learning and development activities undertaken in the intervening period.

0.3.4 Maintaining and developing competence

Competence can become out of date over time and requires positive action to maintain. This includes building on and refreshing skills, knowledge and understanding, identifying specific requirements relevant to work being undertaken and keeping abreast of changes in context such as regulation or technology.

Maintaining competence (through continuing professional development or CPD) includes informal and formal activities. This can include activities such as training and refresher courses, toolbox talks and mentoring or supervision and formal learning.

Improving competence through the development of new skills is equally important in relation to new or changing building knowledge, technology or practices, particularly where this can impact on building safety or consumer protection.

CPD is best undertaken as part of a planned programme of activity or recorded personal development plan relevant to the individual's responsibility and career path. It is considered good practice for employers to adopt a framework for assessing the effectiveness of CPD undertaken by their employees and contracted individuals.

To aid in consistency, it is beneficial for competence frameworks to set out expectations for maintaining competence for the different roles, functions, activities and tasks to which they apply. This includes not only the type, scale and complexity of the work being undertaken when measured against established skills, knowledge and experience, but also any new context or standards affecting behavioural requirements.

0.3.5 Limits of competence

It is vital that people do not act beyond the limits of their competence to avoid exposing themselves and potentially other people to a wide range of risks. This includes risk of death or injury, litigation, prosecution and breach of contract (amongst others).

It is important that competence frameworks and training and development regimes establish the right conditions so that individuals are able to take reasonable steps in managing limits of competence. This might include:

a) making provision so that people are aware of how to manage the limits of their own competence, and in particular that they are able to identify when they have been tasked with or are about to undertake something that exceeds their ability to do so safely;
b) enabling a culture where it is seen as the right thing to do to flag concerns about limits of competence, and where individuals have the necessary authority to act to mitigate risks;
c) managing limits of competence of self and others under direct supervision including taking mitigating actions (such as providing additional training) or managing risks (i.e. by reallocating work to suitably competent people); and
d) being aware of when and how to check that third parties who are procured, appointed or contracted to undertake work are in themselves competent to manage limits of their own competence and those working under their supervision and that they have appropriate tools and resources to do so.

A positive culture of both disclosure and trust is required such that people and organizations are willing to acknowledge and manage the limits of their competence.

0.4 Mapping against this BSI Flex

0.4.1 General

There are many existing competence frameworks which have been developed prior to this BSI Flex.

Compliance with this BSI Flex can be demonstrated through a process of mapping rather than through direct adoption of its structure and terminology. Mapping can also be used in the development of new sector-specific competence frameworks to help achieve alignment with the recommendations of this BSI Flex.

The recommended approach to undertake mapping against this BSI Flex involves:

a) clearly identifying the scope of the sector-specific framework, including the roles, functions, activities, tasks, sector and context;

b) creating a mapping template listing the recommendations set out in Clause **4**, Clause **5** and Clause **6**; and

c) reviewing the sector-specific framework to:

   1) verify conformity to the core criteria described in Clause **4**, Clause **5** and Clause **6**, taking into account relevant scope;

   2) record how and where this evidence of conformity is set out in the sector-specific framework;

   3) analyse any areas where the sector-specific framework does not address the core criteria of this BSI Flex; and either

      i) amend the framework as necessary to demonstrate conformity; or

      ii) clearly justify any non-conformity or divergence from the requirements, taking into account the context, roles and functions covered by the sector-specific framework whilst recognizing the overall objective of improving standards of competence.

In undertaking this comparison process, consideration is to be given to how each sector-specific framework interacts with other individuals, organizations, roles, functions, activities and tasks in any way which could affect safety or quality. This helps break down siloed competence and helps to ensure that sector-specific frameworks cover collaborative competence where roles or activities interface.

0.4.2 Informative annexes

The following informative annexes are provided to support the development of core competence for building safety in sector-specific competence frameworks:

- Annex A (informative) Behavioural competence;
- Annex B (informative) Fire and life safety in buildings;
- Annex C (informative) Structural safety in buildings; and
- Annex D (informative) Public health and public safety in buildings.

These annexes are intended to provide basic awareness of the scope of common building safety considerations. Their primary purpose is to support framework owners to identify relevant areas of building safety competence (including interfaces with other roles, functions or activities) that could affect building safety outcomes.

The informative annexes are not intended as comprehensive or to be relied upon as the sole source of evaluation of scope of building safety competence.

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1 Scope

This BSI Flex gives recommendations for core criteria for building safety to promote high standards of protection for people in and around buildings. It is applicable to buildings of all types and scales. It is intended to have wide application and relevance in modern construction and property markets throughout the UK and beyond.

Building safety in the context of this BSI Flex relates to the physical conditions created by new or existing buildings, their immediate surroundings and how these impact on the safety of occupants throughout the building lifecycle. This BSI Flex does not cover other matters which might affect safety, such as policing or crime.

This BSI Flex is intended for use by those with responsibility for the development, maintenance or application of sector-specific competence frameworks for roles, functions, activities or tasks undertaken by individuals where these are critical to and directly influence safety in and around buildings. This includes competence frameworks for technical and non-technical roles, and for individuals working under their own authority as well as under the supervision of other competent individuals.

This BSI Flex might also be relevant to regulated, duty-holding or statutory roles such as:

- Principal Designers;
- Principal Contractors;
- Designers;
- Contractors;
- Building Safety Managers;
- building control professionals; and
- responsible persons for buildings in occupation.

NOTE *Responsibility for ensuring that sector-specific frameworks are kept up to date rests with framework owners given that the scope of regulation and duty-holding roles is likely to change over time.*

Persons with accountability for building safety or acting as clients for building work might also find the recommendations of this BSI Flex of use.

This BSI Flex is not intended to replace existing professional, technical or vocational training or competence frameworks which continue to reflect the full range of competences required for particular disciplines, roles, functions, activities or tasks.

This BSI Flex does not cover organizational and team competence.

2 Normative references

There are no normative references in this BSI Flex.

3 Terms and definitions

For the purposes of this BSI Flex, the following terms and definitions apply.

3.1 behaviour

observable things that an individual does or does not do

3.2 building safety

matter relevant to protecting the safety of people from risk in and around buildings (including but not limited to fire safety, structural safety, public health and public safety) and pertaining to the specification, design, manufacture, procurement, construction, inspection, assessment, management, operation, maintenance, refurbishment and demolition of buildings

3.3 building system

assembly of construction products

3.4 competence

application of skill, knowledge, experience and behaviour consistently to achieve a specific outcome

3.5 competence assessment

evaluating and documenting evidence of an individual's performance against competence requirements

3.6 competence framework

procedures and requirements for the development, assessment and maintenance of agreed skills, knowledge, experience and behaviours required for an individual undertaking a role, function, activity or task in order to perform their work to predetermined standards and expectations and maintain or improve their performance over time

3.7 competence management

systematic identification, development, assessment, deployment and maintenance of the skills, knowledge, experience and behaviours required to fulfil responsibilities and to perform activities or tasks to recognized standards of competence

3.8 construction product

product, substance or collection thereof that has been manufactured, refined or processed and declared by its manufacturer for an intended end use for temporary and/or permanent inclusion in building or civil engineering works, refurbishment or maintenance

3.9 continuing professional development (CPD)

activities undertaken by an individual to maintain and develop competence, including formal and informal learning, self-assessment, obtaining feedback and identifying areas for improvement

3.10 dutyholder

person or organization with specific legally prescribed responsibilities

3.11 experience

participation in relevant activities or observation of facts and events leading to acquisition or improvement of knowledge and skills

3.12 formal learning

organized and structured learning objectives

3.13 framework owner

person(s) involved in the development, oversight and maintenance of a competence framework

3.14 golden thread of information

recording, developing, collecting, organizing and sharing of information by dutyholders or accountable persons in accordance with prescribed standards to ensure building safety throughout the lifecycle of a building

3.15 higher-risk building (HRB)

building subject to enhanced regulatory requirements or where risks might be considered elevated

NOTE *For example, as a result of the physical characteristics of the building, the way in which the building is used or as a result of human factors*

3.16 individual

single human being

3.17 informal learning

self-directed learning or learning from experience

3.18 knowledge

assimilation of facts, theories and practices in relation to a given role, function activity or task.

3.19 occupant

resident, worker, visitor or other person in and around a building

3.20 prior learning

formal or informal learning used as a reference point for the likely skills, knowledge and experience required to competently undertake a specific role, including qualification, certification and training

3.21 public health

protection of health and wellbeing

3.22 revalidation

formal process of reassessing an individual's competence on a periodic basis to check that competence has been maintained

3.23 resident

person who lawfully resides in a building

3.24 safety case

structured argument supported by a body of evidence that provides a compelling, comprehensible and valid case as to how building safety risks are being proactively managed

3.25 sector-specific competence framework

competence framework relevant to a specific role, function, activity, task, trade or discipline

3.26 skills

ability to perform an activity or task consistently with a specific intended outcome

3.27 validation

formal process of assessing an individual's competence against a sector-specific competence framework

4 Core criteria for structure of sector-specific competence frameworks

4.1 General

All sector-specific frameworks should demonstrate how the core criteria set out in Clause **4** are met.

NOTE *It is recognized that sector-specific frameworks will differ in structure and content. To enable effective interaction between roles, sectors and disciplines, it is important that sector-specific frameworks are effectively coordinated and include some common requirements, consistent language and a holistic approach to building safety. Also, it is desirable that interactions and interfaces with other related activities are taken into account.*

4.2 Overview

Sector-specific competence frameworks should:

a) set out their intended purpose;

b) explain the background to the development of the framework;

c) explain relevant principles and concepts relating to competence, competence management, validation and revalidation;

d) provide an overview of the use and application of the framework;

e) state how, when and by whom the sector-specific competence framework has been assessed and approved (including any oversight and evaluation by third party bodies); and

f) state how, when and by whom the framework is to be reviewed.

NOTE *Attention is drawn to the need for reasonable adjustments in line with relevant equality legislation to ensure that competence assessment, validation and revalidation is accessible to the widest possible range of people.*

4.3 Relevant sectors

Sector-specific competence frameworks within the scope of this BSI Flex should:

a) define the built environment sector(s) in scope, stating any specific exclusions; and

b) identify any specific types of organization within which individuals are likely to be subject to competence assessment against the sector-specific framework.

NOTE *It might be appropriate to reference Standard Industrial Classification (SIC) in defining relevant sectors.*

4.4 Roles in scope

Sector-specific competence frameworks should:

a) define the specific roles, functions, activities and tasks for which the framework can be used to assess competence, clearly identifying any specific exclusions ;

b) signpost where further information on relevant statutory roles and duty-holding responsibilities can be found; and

c) indicate where guidance on procedural requirements for competence assessment can be obtained.

NOTE *It might be appropriate to reference Standard Occupational Classification (SOC) in defining relevant sectors.*

4.5 Types of building operations and/or building work in scope

Sector-specific competence frameworks should:

a) define the types of building operations or building work in scope, clearly identifying any specific exclusions; and

b) define the types of activity and/or tasks in scope.

NOTE *For instance, any or all of building work, design, manufacturing, construction, maintenance or operation.*

4.6 Regulatory or legislative requirements for validation or revalidation

Sector-specific competence frameworks should:

a) identify and explain regulatory or statutory regimes relevant to the need for competence of individuals to be validated or revalidated against the framework; and

NOTE *This relates to legal requirements for individuals to have their competence assessed, not regulatory or statutory regimes relevant to the individual's role.*

b) signpost where further information on these regulatory or statutory regimes can be found.

4.7 Prior learning

Sector-specific competence frameworks should define any prior learning requirement, either as a pre-requisite for, or as part of, validation or revalidation. They should:

a) set out any requirement for prior learning, including but not limited to:
   1) training;
   2) formal qualification;
   3) certification;
   4) academic or vocational education; and
   5) experience;
b) define any procedure for assessing equivalence to prior learning requirements where applicants do not possess the formal qualification or learning required;
c) map prior learning requirements to learning levels in the relevant national qualification framework; and
d) define any procedures for accepting qualifications, learning or equivalence gained via other sector-specific frameworks.

4.8 Competence levels and standards

Sector-specific competence frameworks should set out:

a) general areas of competence and specific competencies;
b) any differing levels or standard of competence which are to be met; and
c) how levels or standards of competence (or competence levels) have been developed and defined, including by reference to relevant national qualification frameworks

NOTE *Levels of competence can be expressed in various ways, but sector-specific frameworks explain how these levels relate to measurable characteristics. In some bodies this might be reflected by, for example, grades of membership.*

4.9 Validation

Sector-specific competence frameworks should set out:

a) the intended approach to validation of individuals; and

   NOTE *For example, through third party certification or professional registration.*

b) formal titles, descriptors or registration arrangements indicating successful validation against a framework.

4.10 Revalidation

NOTE 1 *It is considered good practice that revalidation occurs at least once within every five-year period, even if there is no regulatory requirement to do this. Sector-specific frameworks might also require more frequent revalidation due to changes in acceptable practice, or where codes, standards or regulations have introduced new expectations.*

Sector-specific competence frameworks should set out:

a) the intended approach to revalidation of individuals; and
b) any defined time periods for revalidation.

NOTE 2 *Items a) and b) might vary in relation to different roles covered by a single framework.*

4.11 Requirements for maintaining competence

Sector-specific competence frameworks should:

a) set out the requirements for individuals to maintain and develop the currency of their competence for the role, function or task they undertake;
b) define expectations in terms of the activity required to maintain competence, including but not limited to:
   1) time periods;
   2) learning levels;
   3) types of learning (e.g. formal or informal); and
   4) subject area;
c) set out procedures or requirements for monitoring of competence; and
d) set out procedures for sanctioning failure to meet requirements to maintain, record or disclose CPD or other activities to maintain competence.

4.12 Ability to check the competence of individuals validated against the framework

Sector-specific competence frameworks should set out:

a) the intended approach to members of the public accessing information on the validation or revalidation of individuals;

b) what information is to be held on individuals determined competent under this framework;

c) which of the information held is to be publicly available and how this is to be made accessible to a wide range of users;

d) details of how dutyholders or members of the public are to be able to check the competence status of an individual validated in accordance with the sector-specific competence framework, e.g. through publicly accessible registers.

NOTE *Information on sector-specific frameworks need to be provided in formats and media which are inclusive and accessible to a wide range of people including building occupants.*

5 Behavioural competence for building safety

*COMMENTARY ON CLAUSE **5***

*Ensuring that people possess appropriate behavioural competence is critical to achieving and maintaining building safety outcomes. The core competence criteria in this clause are therefore considered foundational in enabling people to act competently in respect of the core competence criteria in Clause **6**.*

All sector-specific frameworks should incorporate or be able to demonstrate alignment with the core behavioural competences for building safety set out in Table 1 at an appropriate level relevant to the role, function, activity or task within their scope.

***NOTE 1** The scopes in each table are non-exhaustive examples, some or all of which might be relevant to the context of any given sector-specific framework. It is intended that frameworks evaluate and address this scope where relevant. Otherwise, sector-specific frameworks are to add, subtract or amend scope in order to address the core competence criteria, taking into account the context, roles, functions, tasks or activities covered by that framework.*

***NOTE 2** Core competence criteria are descriptors of capability at a role or function level. It is for sector-specific frameworks to set out more specific requirements at an activity or task level (referred to as competency or competencies) where appropriate.*

***NOTE 3** Guidance on key behavioural and ethical practice is provided in Annex A.*

Table 1 – Behavioural competence

Core competence criteria	Scope
a) Act ethically and contribute to safe outcomes	1) Ethical principles to promote safe outcomes, including: i) respect for life, the law, environment and public good; ii) honesty and integrity; iii) accuracy and rigour; and iv) responsibility for direction, conduct and communication. ***NOTE** Informative text on these ethical principles is provided in Annex A.* 2) Relevant codes or standards of conduct. 3) Respect for diversity and principles of inclusivity. 4) Application of sound judgement including anticipating, identifying, analysing and solving problems to support safe and effective outcomes.
b) Demonstrate effective leadership, teamwork and communication as an individual or as a member of a team: • demonstrate commitment to strong safety culture; • collaborate effectively and collectively, as part of a team; and • communicate effectively	1) Visible commitment at all levels to a strong safety culture. 2) Collaboration with others and effective team working skills. 3) Effective communication within and between teams, organizations and individuals. 4) Listening and feeding back effectively 5) Communicating technical information to non-technical audiences. 6) Communicating effectively through use of oral, written, drawn, digital or graphic information and in accessible formats.

Table 1 – Behavioural competence *(continued)*

Core competence criteria	Scope
c) Manage individual and contribute to organizational competence: • manage own competence; • manage competence of others where appropriate; and • maintain competence and contribute to learning culture	1) Acting within limits of own competence (particularly in relation to building safety) and seeking further appropriate advice where necessary. 2) Maintaining competence including undertaking self-assessment and personal development activities. 3) Managing competence of others including fulfilling dutyholder obligations when making appointments or allocating tasks within teams. 4) Recording, monitoring, analysing and acting to improve outcomes as part of a learning culture.
d) Demonstrate personal responsibility and accountability: • understand personal role and responsibilities with particular reference to safety; • accept and manage accountability for individual actions; and • understand responsibility and accountability for collective actions	1) Responsibility for own actions and for the actions of those under their supervision or direction. 2) Managing boundaries/interfaces of responsibility and communicating these effectively to others. 3) Anticipating, identifying and challenging unsafe or inappropriate behaviours and escalating concerns through reporting or whistleblowing mechanisms. 4) Identifying and providing feedback on unsafe process, equipment, procedures, construction products, building systems, standards or quality.
e) Understand and respect duty of care to others including building occupants: • duty of care to public and building occupants; • duty of care to co-workers; and • duty to communicate with persons outside the project team and respond to reported risks or concerns	1) Duties and obligations to act in protecting safety of self, colleagues and the public whilst undertaking work. 2) Duty of care to occupants including residents, first responders and people in and around buildings in use. 3) Consultation, listening and engagement with occupants or others who are or could be affected by work (including vulnerable, older and disabled people) and responding appropriately.

6 Core criteria for building safety

*COMMENTARY ON CLAUSE **6***

The core competence criteria represent the shared understanding necessary so that individuals working on buildings are able to act responsibly and contribute to safe outcomes which protect the safety of occupants and building users throughout the building lifecycle.

These core competence criteria are likely to be relevant to all sector-specific frameworks used to assess or develop competence of individuals. They are grouped under four key headings:

- *Fire safety, structural safety and public safety – sets out core criteria primarily relating to the design, construction or undertaking of building work covering fire, structural, public health and public safety;*
- *Managing building safety – sets out core criteria primarily relating to management activities including fulfilling duty-holding roles, managing risk in occupation, managing safety during procurement and providing suitable insurance or warranty to protect consumers;*
- *Knowledge management and communication – sets out core criteria for managing the golden thread of information through the building lifecycle and for communication between and within project, management and client teams, and with occupants including residents; and*
- *Buildings as systems, building systems and construction products – sets out core criteria relating to consideration of buildings as holistic systems including construction products and building systems.*

6.1 General

Sector-specific competence frameworks should:

a) demonstrate how they address each of the core competence criteria set out in Table 2 to Table 5;

b) demonstrate how scope has been contextualized to reflect the roles, functions, activities and tasks covered by that framework and

c) establish the appropriate level of competence required for validation or revalidation against each of the core competence criteria in the context of the roles, functions, activities and tasks covered by that framework.

***NOTE 1** The* scope *in each table* comprises *non-exhaustive examples, some or all of which might be relevant to the context of any given sector-specific framework.* It is important that *frameworks* evaluate and address this scope *where relevant. Otherwise,* it is intended that *sector-specific frameworks add, subtract or amend* scope *in order to address the core competence* criteria*, taking into account the context, roles, functions, tasks or activities covered by that framework.*

***NOTE 2** Core competence criteria are descriptors of capability at a role or function level. It is for sector-specific frameworks to set out more specific requirements at an activity or task level (referred to as competency or competencies) where appropriate.*

6.2 Fire safety, structural safety and public safety

All sector-specific competence frameworks should demonstrate how they meet the core competence criteria set out in Table 2, contextualized and at an appropriate level relevant to the role, function, activity or task within the framework's scope.

Table 2 – Fire safety, structural safety and public safety

Core competence criteria	Scope
a) Understand and contribute to development and application of fire safety strategies, practices and technological systems in buildings	1) Foundation principles of fire safety, including: i) principles of fire chemistry and physics, including ignition and heat transfer; ii) the influence of structure, construction product selection and buildings systems on fire safety performance; iii) human behaviour and escape requirements; and iv) methods of fire suppression and how to limit fire growth and fire spread. 2) Fire safety design concepts and strategies that enable safe use and occupancy of a building including integration of principles of inclusive design. 3) Mitigation and control functionalities of fire protection technologies and systems that detect, alert, confine fire growth and effluents, suppress ignition and fire, ventilate and secure escape or reduce fire spread; and reduce risks involved in firefighting and rescue.
b) Understand and contribute to fire safety in buildings through legislative controls: • design for fire safety; and • construct and install in accordance with compliant design intent	1) Regulatory and legal frameworks to protect people and property from fire through fire safety requirements including statutes, building regulations/standards and advisory documentation. 2) Statutory requirements; to aid warning and escape; for facilities to enable access and intervention by the fire and rescue services; for containment of fire and to support extinction. 3) Requirements for exchange of fire safety information.
c) Contribute to fire safety in buildings during occupation	1) Requirements for audits, inspections and risk assessments so that means of escape and fire protection systems in buildings (including physical and technological means) remain available throughout a building's life, appropriate to occupancy, use, construction and level of fire risk. 2) Maintaining compartmentation and sustaining function of fire protection systems during occupation and when undertaking works to existing buildings.

Table 2 – Fire safety, structural safety and public safety *(continued)*

Core competence criteria	Scope
d) Contribute to establishing and maintaining structural safety in buildings	1) Key principles of structural design and construction, including characteristics of structural systems and their behaviours under load and in the event of fire. 2) Provisions of building regulations, codes and standards in relation to structural stability of primary structure, secondary structure and fixings. 3) Requirements for maintaining structural safety including instructing, planning or undertaking assessment, inspection, or maintenance tasks. 4) How and when to respond to events which can affect structural safety including how to procure competent specialist advice when necessary.
e) Contribute to establishing and maintain public health and public safety in buildings	1) Compliance with all relevant provisions of building regulations or applicable codes/standards for public health and public safety. ***NOTE*** *This includes but is not limited to regulatory requirements covering:* • *radon, methane and site contamination including asbestos;* • *waste and grey water drainage and rainwater recovery systems;* • *electrical safety including lightning protection;* • *gas supply and combustion appliance safety including carbon monoxide detection and the provision of devices and information for identifying and isolating gas supply;* • *ventilation;* • *moisture, damp and condensation risk;* • *water supply and storage including hot water safety and public health risks, such as Legionella;* • *overheating and heating failure;* • *stairs, glazing, guarding and balustrading safety; and* • *lift and escalator safety.* 2) Management, maintenance, installation or replacement requirements for construction products or building systems necessary to protect public health and public safety. 3) Inspection, assessment, testing and monitoring requirements relating to public health and public safety.

6.3 Managing building safety

All sector-specific competence frameworks should demonstrate how they meet the core criteria set out in Table 3 contextualized and at an appropriate level, relevant to role, function, activity or task within the framework's scope.

Table 3 – Managing building safety

Core competence criteria	Scope
a) Understand and, where relevant, fulfil roles, responsibilities and duties critical to building safety	1) Interaction with or fulfilment of duty-holding roles: ***NOTE*** *For example, but not exclusively:* *a) client;* *b) accountable persons;* *c) Principal Designer;* *d) Principal Contractor;* *e) Designer;* *f) Contractor;* *g) Building Safety Manager;* *h) responsible persons; and* *i) occupants.* 2) Obligations to raise, escalate or flag risks to life safety during the design, manufacture, construction, maintenance or management process including whistleblowing and mandatory reporting regimes. 3) Boundaries of responsibility including the scope of the specific building safety responsibilities or systems under own control.
b) Understand and contribute to relevant risk assessment processes and activities, including: • fire risk assessment • safety case development • design risk management • major incident plans • occupants and residents information • residents engagement plans	Control measures to mitigate risk posed by threats to life safety: 1) identify risk and safety issues; 2) gather, analyse, use and share data to inform risk assessment; 3) use risk assessment process and information to guide actions, decisions and activities; 4) develop and implement control measures to mitigate risks posed to safety throughout the building lifecycle.
c) Manage building safety in occupation, operation, installation and maintenance and, where relevant, take appropriate actions to manage building safety	1) Good housekeeping and fire safety practices amongst residents. 2) Information, training and education on building safety matters to community and residents as required and in accessible formats. 3) Control of factors affecting building fabric or building systems to maintain compartmentation and prevent fire spread. 4) Interaction between building users/residents and building safety taking into account human factors.

Table 3 – Managing building safety *(continued)*

Core competence criteria	Scope
d) Contribute to safe practice in procurement and operational management activities, including pricing, purchasing and contracting so as to prevent building safety outcomes and performance being compromised by decisions about cost	1) Safety implications of procurement pathways, cost management, pricing, purchasing, change control and product selection taking into account: i) impact of client instructions and procurement decisions on holistic building safety performance; ii) use of alternative construction products, solutions or building systems with potential to affect holistic building safety; and iii) mitigating actions to avoid building safety being adversely affected by cost, management, specification or commercial decisions. 2) Checking building safety competence of persons undertaking activities linked to safety during specification, design, construction, occupation, operation, installation, maintenance, demolition and necessary mitigating actions.
e) Understand requirements for insurance, warranty or other protections, including those enabling routes of recourse to address building safety defects	1) Public, professional, property, construction product and business insurance. 2) Warranties or guarantees on construction products, building systems or building work.

6.4 Knowledge management and communication

All sector-specific competence frameworks should demonstrate how they meet the core criteria set out in Table 4 contextualized and at an appropriate level relevant to role, function, activity or task within the framework's scope.

Table 4 – Knowledge management and communication

Core competence criteria	Scope
a) Contribute to the recording of, development, collection, organization, and sharing of information about the building's design, construction, operation, maintenance and refurbishment throughout the building lifecycle to ensure the golden thread of information is preserved b) Obtain, record, update, share, safeguard and keep secure information about the building	1) Requirements for documented building safety information at a project, premises and organizational level. 2) Capture, issue and maintenance of life safety information; identification of records that should be kept and how those should be retained; obtaining and managing access to life safety information; maintain the golden thread of information, including (but not limited to): i) digital systems including building management systems, digital records and building information modelling and digital engineering standards and systems; ii) safety management systems; iii) safety case; iv) health and safety file; v) fire risk assessment and emergency plans; vi) as-designed/as-built information; vii) building safety strategies; viii) building maintenance information and scheduling; ix) testing and commissioning information including acceptance reports; x) inspection reports and any declarations, sign off or notices xi) lifecycle and replacement data; xii) HRB records and certificates; xiii) data protection and cyber security; xiv) management of deleterious materials including asbestos; xv) information relating to temporary works; xvi) information relating to safe demolition and disposal of building materials; and xvii) operation manuals. 3) Research to obtain information, or identify and highlight missing information, relevant to building safety, especially in existing buildings. 4) Requirements for information to be available to building occupants including residents, visitors and staff.
c) Effectively communicate issues relating to risk or safety with occupants including residents, clients and members of project or management teams.	1) Requirements/obligations and duties for transparency regarding building safety information, communication, consultation and response to occupants including residents, emergency services or persons otherwise affected by building and building work, such as dutyholders, clients and project team members. 2) Balanced, proportionate and factual explanation of where risks to life safety have been identified, the potential consequences and need for clear recommendations for mitigating measures.

6.5 Buildings as systems, building systems and construction products and materials

All sector-specific competence frameworks should demonstrate how they meet the core criteria set out in as set out in Table 5, contextualized and at an appropriate level relevant to role, function, activity or task within their scope.

Table 5 – Buildings as systems, building systems and construction products

Core competence criteria	Scope
a) Coordinate building design, management or construction activities to ensure holistic building safety	1) Appropriate selection for intended use so that construction products and building systems function individually and together to maintain building safety and consider buildings as holistic systems. 2) Impact of installation quality on construction product and building system performance and need for quality assurance and quality management processes. 3) Requirements for construction product durability over time taking building use into account. 4) Consideration of location and context in construction product performance and selection, e.g. proximity to boundary, boundary conditions (fire resistance, water resistance) size, distance, environmental conditions, geometry.
b) Understand construction products, and building system characteristics, and utilise testing, assessment and maintenance information and procedures to minimize risks to safety throughout the building lifecycle	1) Use of construction product or building system testing information including certification, classification and industry approved or recognized standards (alongside as-built design and construction information on existing buildings), to inform design, specification, construction, installation and management decisions. 2) Maintenance requirements for construction products and building systems through the building lifecycle, including planning, procuring, monitoring, undertaking or managing maintenance of building fabric, fire protection or life safety systems. 3) Replacement (and safe disposal) of construction products and buildings systems at the end of their lifecycle to maintain building safety. 4) Notification of building operators, suppliers and manufacturers where defects or maloperation issues are found in construction products or building systems which impact on building safety.

Annex A (informative) Behavioural competence

COMMENTARY ON ANNEX A

This annex provides an overview of behavioural competence to assist in the development or review of sector-specific competence frameworks. It is not comprehensive and is intended to provide a basic awareness of key concepts in behavioural competence relevant to any given discipline, role, function, activity or task. The guidance contained within this annex does not constitute a provision of this BSI Flex.

A.1 General behavioural competence

Clients, organizations and businesses working in the specification, design, manufacture, procurement, construction, inspection, assessment, management, operation, maintenance, refurbishment and demolition of buildings (including the manufacture of their components and systems) are often subject to high levels of competition and intense cost and time pressures often driven by contractual and procurement conditions.

It is recognized that these pressures can, if unchecked, lead to the development of customs and practices which increase risk to co-workers and to the public and can incentivize unethical or undesirable behaviours. This can have significant implications for building safety.

A strong safety culture founded in effective behaviours is needed to re-balance any unsafe custom and practice.

The safety culture of an organization is understood to be the product of individual and group values, attitudes, perceptions, competences and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization's management. To achieve the desired culture change in built environment industries requires integration of effective behavioural competence relevant to the role, function, task and activities of individuals.

***NOTE** This BSI Flex relates to sector-specific frameworks for individual competence. Organizational competence and capability are derived from the combination of individual competence within or deployed by an organization and is a separate topic of substance but is referred to in order to provide broader context.*

This annex provides informative text on the core requirements for behavioural competence and ethical standards recommended by this BSI Flex. These behavioural competences are intended to underpin safe outcomes and the development of a positive safety culture throughout the supply chain and building lifecycle, ensuring as far as possible that poor conduct and risky behaviours are not tolerated and are challenged.

The key aspects of a positive safety culture identified by the Health and Safety Executive (HSE) include:

- management commitment which promotes high levels of concern throughout an organization;
- visible management which leads by example and demonstrates engagement and takes action;
- good communication at all levels, where health and safety is a natural, unprompted consideration; and
- active participation and ownership of health and safety issues, with a common interest and narrative at all levels of the organization, including visitors.

In the context of this BSI Flex there are five key behaviour sets considered important in demonstrating suitable behavioural competence:

- ethical principles, standards and conduct;
- leadership, teamwork and communication;
- individual and organizational competence;
- personal responsibility and accountability; and
- duty of care to others including building occupants.

In combination, these behavioural competences can mitigate risks from bad practice and incentivize good behaviours.

A.2 Ethical principles, standards and conduct

A.2.1 General

It is important that behavioural competence frameworks are supported by clearly defined ethical principles and standards relevant to the roles, functions, activities and tasks they cover. These are central to and interlinked with all other behavioural competences.

In the context of this BSI Flex, ethics are understood as the moral principles and standards which underpin sound judgement and provide people with the moral authority to take responsibility for their actions and the actions of others. Ethics enable complex judgements to be made about what is right and what is wrong and help balance commercial considerations with wider duties to society and other people.

Critically, ethical standards and principles help to guide an individual's choices when guidance or regulations do not seem to apply, or when experience cannot be relied upon. There are several branches of ethics and each might give a different answer to a given problem; but ethics can help resolve confusion and clarify choices where objectives are ambiguous, where several objectives conflict, or where an outcome affects others who hold different views.

This BSI Flex has adopted the normative (rules-based) branch of ethics and ethical principles – these are criteria that explain what is morally right or wrong in the context of how the decisions and actions of individuals and organizations ought to shape daily life. This includes:

- respect for life, law, the environment and public good (**A.2.2**);
- honesty and integrity (**A.2.3**);
- accuracy and rigour (**A.2.4**); and
- responsibility for direction, conduct and communication (**A.2.5**).

NOTE *These ethical standards are based on the Royal Academy of Engineering and Engineering Council's Statement of Ethical Principles 2017 as adapted by the Competence Steering Group (CSG) in 2019. (www.engc.org.uk/standards-guidance/guidance/statement-of-ethical-principles/)*

In practice, the core ethical principles are relevant to all individuals and most commonly found in codes of conduct and personal performance standards. Ethical principles are often integrated into academic and vocational training, reinforced by induction and development and supported by values-driven, accountable organizational leadership, by management procedures and on the job training, e.g. toolbox talks, interaction, reflection and CPD.

A.2.2 to **A.2.5** set out in more detail behaviours that support ethical conduct. These can be used as a starting point to assess and develop more specific competencies relevant to the role, function, activities and tasks being undertaken by individuals.

A.2.2 Respect for life, law, the environment and public good

All those involved in the specification, design, manufacture, construction, inspection, assessment, management, operation, maintenance, refurbishment and demolition of buildings have a duty to be familiar with all applicable laws and regulations and give due weight to facts, published standards and guidance and the wider public interest. This includes acting to:

a) hold paramount the health and safety of others and draw attention to hazards;
b) ensure their work is lawful, ethical and justified;
c) recognize the importance of physical and cyber security and data protection;
d) respect and protect personal information and intellectual property;
e) protect, and aim to improve, the quality of built and natural environments;
f) maximize the public good and minimize both actual and potential adverse effects for their own and succeeding generations; and
g) take due account of the limited availability of natural resources.

A.2.3 Honesty and integrity

All those involved in the specification, design, manufacture, procurement, construction, inspection, assessment, management, operation, maintenance, refurbishment and demolition of buildings have a duty to uphold the highest standards of personal conduct including openness, honesty and integrity. This includes:

a) acting in a reliable and trustworthy manner and treating others with equality and fairness;
b) being alert to the ways in which their work and behaviour might affect others and respect the privacy, rights and reputations of other parties and individuals;
c) respecting confidentiality;
d) declaring and managing conflicts of interest;
e) avoiding deception and taking steps to prevent or report corrupt practices or professional misconduct; and
f) rejecting bribery and improper influence.

A.2.4 Accuracy and rigour

All those involved in the specification, design, manufacture, procurement, construction, inspection, assessment, management, operation, maintenance, refurbishment and demolition of buildings have a duty to acquire and use wisely the understanding, knowledge and skills needed to perform their role or task. This includes:

a) always acting with care;
b) performing services only in areas in which they are currently competent or under competent supervision;
c) keeping their knowledge and skills up to date;
d) assisting the development of knowledge and skills in others;
e) presenting and reviewing theory, evidence and interpretation honestly, accurately, objectively and without bias, while respecting reasoned alternative views;
f) identifying, evaluating, quantifying, mitigating and managing risks; and
g) not knowingly misleading or allowing others to be misled.

A.2.5 Responsibility for direction, conduct and communication.

All those involved in the specification, design, manufacture, procurement, construction, inspection, assessment, management, operation, maintenance, refurbishment and demolition of buildings have a duty to abide by and promote high standards of personal conduct, communicate clearly and provide direction as appropriate, setting the example for others to follow. This includes:

a) being aware of and seeking to effectively communicate the issues that the built environment raises for society;
b) communicating as unambiguously and openly as possible to avoid misinterpretation;
c) promoting equality, diversity and inclusion, and respect the views of others;
d) promoting public awareness and understanding of the impact and benefits of new areas of learning, achievements and innovation in industry;
e) being objective and truthful in any statement made in their personal or professional capacity; and
f) challenging statements or policies that cause them personal or professional concern.

A.3 Behavioural competencies

A.3.1 Leadership, teamwork and communication

Building safety extends beyond workplace safety cultures to include consideration of safety for all those who will interact with a building across its lifespan. This requires a change in behaviour to recognize and act on these longer-term responsibilities.

Strong and visible commitment to prioritize building safety is required from senior management to develop and sustain effective safety cultures within organizations. This requires leadership at the top, but leadership on safety is also required at every level throughout the organization, including within teams and by individuals in positions of responsibility.

Safety culture also requires projects and management practices where collaboration and teamwork are encouraged. People have to be empowered to take action where they have concerns and there has to be a safety positive culture where those concerns are listened to and acted upon.

In addition, communication has to be effective in all directions within and between organizations to identify and manage safety risks.

A.3.2 Individual and organizational competence

To act safely, people have to understand the limits of their personal and their organizations competence, operate within these limits and be allowed sufficient time and resource to dedicate to building safety issues. This can include regular peer-supervised or self-assessment activities to identify areas where improvement is required. Ideally these will be translated into personal development plans and activities to maintain or develop competence.

It is also important to support a learning culture which constantly monitors, analyses and acts to improve competence and safety outcomes. This can be facilitated by ensuring people remain equipped with the right competence to make sound decisions which include:

- understanding when decisions have to be made and how to exercise authority in making those decisions;
- listening to and identifying concerns and responding appropriately;
- the ability to analyse likely problems that will be encountered in a logical, structured manner in order to identify necessary actions;

- the ability to identify risks, the consequences of action or inaction, and factor these into decisions;
- the ability to make timely and appropriate decisions and judgements even in the face of ambiguity or uncertainty; and
- knowing what is needed to escalate matters or seek further advice and resources where they are unable to make decisions or judgements themselves.

A.3.3 Individual responsibility and accountability

It is important that competent individuals clearly understand how their actions can impact on others and what is expected of them in taking responsibility for those actions. This includes potential impacts on work colleagues and the general public both during and after they have fulfilled their role.

To achieve this, competence assessment processes can, for example, include requirements for candidates to demonstrate how they take personal responsibility, including:

- taking responsibility for their own actions and the actions of those under their supervision or direction;
- understanding their role and responsibilities in keeping others safe;
- knowledge and understanding of legal duties and responsibilities relevant to their role; and
- the ability to identify where boundaries of responsibility lie and communicate this effectively to/with others.

A.3.4 Duty of care to others including building occupants

A positive safety culture requires that everyone with individual responsibility for safety in the built environment understands that buildings have the potential to cause harm to others throughout the building's lifecycle, including during occupation. It is important that individuals recognize where they have a duty of care to protect people's safety and act accordingly. This includes:

- ensuring competence to design, construct, maintain and manage buildings safely;
- understanding the importance of effective consultation and communication with clients, residents and others likely to be affected by buildings or building work; and
- consideration of factors affecting diversity and inclusion for individuals who will occupy or be affected by the building or building work.

Annex B (informative)
Fire and life safety in buildings

COMMENTARY ON ANNEX B

This annex provides an overview of common fire safety considerations in buildings to assist in the development or review of sector-specific competence frameworks. It is not comprehensive but can be used as a starting point to develop an awareness of fire safety relevant to any given discipline, role, function, activity or task. The guidance contained within this annex does not constitute a provision of this BSI Flex.

B.1 Expectations in terms of fire safety competence

B.1.1 There are many specialized roles relating to fire safety which require high levels of competence. However, it is equally important to recognize that most roles have the potential to impact on fire safety. To make sure that fire safety risks are appropriately managed across the building's lifecycle it is critical to identify the varying levels of awareness and competence for which all individuals involved in work in the built environment have responsibility. This includes:

a) building occupants including residents;
b) any individual involved in the manufacture, distribution, procurement or specification of products or systems;
c) designers, including sub-contracted designers;
d) contractors, including installers and subcontractors;
e) accountable and responsible persons, building managers, operatives, and administrators; and
f) those involved in the audit, inspection, maintenance or upkeep of buildings.

B.1.2 Fire safety risks tend to be cumulative – that is, small elements of risk can add up to become a major hazard if left unmanaged. To promote building safety, it is necessary for all participants to clearly understand:

a) the specific responsibilities for fire safety associated with their role or task;
b) how their role interfaces with other fire safety considerations and other disciplines; and
c) how to communicate and manage risk within and between building owners, user organizations and teams.

B.2 Interaction with other key fire safety roles

B.2.1 To maintain fire safety protections, it is advisable to consider how each discipline, role, activity or tasks interact with the other key fire safety factors at different stages of development and management activity.

B.2.2 The aim is to put measures in place so that the roles and responsibilities of these individuals are clearly understood. Competence assessment criteria can then be set so that scope boundaries and interfaces are coordinated, assigned, acknowledged and managed. As a starting point, this includes interactions with following relevant key individuals:

a) resident representation, including:
   1) residents;
   2) residents' associations, panels and representatives;
   3) ombudsmen;
   4) individual residents and households;
   5) tenants; and
   6) leaseholders and persons responsible under legislation;
b) regulators, including:
   1) building safety regulator;
   2) building control bodies;
   3) Health and Safety Executive;
   4) building control inspectors; and
   5) fire safety regulators;
c) fire safety specialisms, including:
   1) fire engineers;
   2) fire risk assessors;
   3) fire and rescue service and other emergency services; and
   4) any other persons appointed as a fire safety specialist, e.g. passive fire protection, active fire safety systems;
d) dutyholders or persons described in legislation, including:
   1) clients and property owners;
   2) accountable person;
   3) responsible person;
   4) Principal Designer;
   5) Principal Contractor;

6) designers;
7) contractors; and
8) Building Safety Managers and facility managers;

e) consultants and representatives, including:
1) architects, architectural technologists, designers and planning advisors;
2) engineers, specifiers and technical specialists including structural, electrical, mechanical, public health, lightning protection and façade engineers;
3) cost consultants and project managers;
4) construction managers and advisers;
5) freeholder or building owner/managing agent;
6) health and safety professionals; and
7) surveyors; and

f) construction, contractors and subcontractors, including:
1) main contractors;
2) subcontractors;
3) contractors and subcontractors with contractual design responsibility;
4) specialist installers of fire safety products, materials or systems; and
5) manufacturers of materials, products and components which require a fire performance classification.

B.3 Characteristics of buildings relevant to fire safety

B.3.1 General

B.3.1.1 From a regulatory perspective, fire safety is typically primarily interested in the protection of life from death or serious injury from fire, rather than vulnerability of the building to loss from fire spread. Buildings presenting the highest fire risk to life or loss / serious damage of property are not necessarily the most complex types of buildings but are premises where life safety risks are considered to be elevated.

B.3.1.2 It is important to promote understanding of the characteristics that make any building higher-risk in terms of occupant safety. These characteristics are fundamental to establishing effective fire safety strategies which influence the design and construction of a building, and subsequently determine the way in which the building is to be managed to remain safe in occupation.

B.3.1.3 Higher-risk building types include:

a) blocks of flats or houses with multiple dwellings (two or more dwellings including houses occupied by residents who do not form a single household);
b) student accommodation;
c) residential care homes;
d) secure residential institutions (e.g. prison, detention centre); and
e) temporary accommodation (e.g. a hotel, hostel, guest house, hospital, hospice).

The common factors in these buildings are:

1) premises primarily used for residential purposes;
2) premises where people sleep, are less alert or less mobile; and
3) premises over 18 m or in excess of six storeys, whichever is met first i.e. tall buildings where the time taken to commence fire-fighting operations may be delayed. Often escape is also more protracted or difficult.

NOTE *It is anticipated that in many areas higher-risk buildings will be defined in legislation which can be subject to change over time, as well as in risk management procedures adopted by fire and rescue services.*

B.3.2 Key characteristics of higher-risk buildings

B.3.2.1 General

Key characteristics that influence whether a building is considered higher-risk are listed in **B.3.2.2** to **B.3.2.6**.

NOTE *This list is not exhaustive.*

While there are many other factors that can affect life safety risk, it is important that the reasons for buildings being classified as higher-risk are understood and taken into account in setting specific competence requirements.

B.3.2.2 Height

Higher buildings require more time if they have to evacuate in the event of an emergency and are more difficult logistically for the emergency services to operate within i.e. to fight a fire in. This is especially so if the fire involves the spread of flame in external walls or other features; if the building has limited internal access and egress routes, making it difficult to assist in evacuation or provide medical assistance; or where it is more difficult to effect rescue through windows above certain heights.

Taller buildings are also often more difficult to maintain and inspect; might have been altered, adapted and changed over periods for different uses, and might have construction defects which are harder to identify and rectify, all of which can impact on the ability to control fire spread

Higher buildings might also have complex control systems such as integrated suppression and smoke control, which require higher levels of operating expertise, maintenance and management.

B.3.2.3 Physical constraints on construction and proximity

Other physical constraints that can impact on fire safety include restricted or limited access for emergency services, waste management arrangements, internal circulation arrangements (e.g. corridors without natural light) and staircase and lift provision. Compensatory features are often put in place to make the risk of such restriction more tolerable, often including fire engineered solutions.

It is important that consideration is given to how fire can spread from one building to another, or affect the safety of people in the immediate vicinity of a building.

B.3.2.4 Occupancy and use

Buildings where people are likely to sleep are generally considered to be higher-risk because of the additional time it takes for sleeping people to become aware of and react to a fire, and because there is often a longer intervening period between a fire starting, being detected and the emergency services being made aware of the need to intervene (be that through an emergency call or other automated fire detection system).

Who occupies a building also has a significant impact on life safety risk. A building with residential premises might be part of a larger multi-use complex, and the way in which the residents manage or are supported to manage their occupancy risk (which might involve health, behavioural or personal constraints) is key to life safety outcomes. In addition, many residential buildings do not implement controls over visitor numbers or whether such visitors might need assistance to escape in a fire.

More vulnerable individuals, including older and disabled people who might need physical assistance to evacuate, individuals who require supervision to react to a fire, such as children or visitors, and persons under the influence of drugs or alcohol are likely to present as being at higher-risk.

These risks might be exacerbated because the design of the building limits means of escape meaning it is important that particular attention (including specific consideration of provision of accessible means of escape) is given to escape provision in buildings including, but not limited to, schools, hospitals, care homes, sheltered housing and hospitality and entertainment venues. These human factors can present difficulties requiring personal emergency evacuation plans to facilitate and manage safe escape from the premises.

Industrial and commercial premises can also present elevated fire safety hazards depending on the use of the building.

B.3.2.5 Familiarity

Where people are regular users or permanent residents of a building it is important that they have access to information and, where appropriate, receive training in how to stay safe and manage fire safety risks. They ought to be made familiar with their own responsibility, and procedures for evacuation in the event of a fire.

Buildings where people are temporary residents (e.g. hotels, hostels, short term lets) or occasional users require different strategies for fire safety to account for lack of familiarity with how to stay safe in the event of a fire. Typically, this involves trained staff or other assistance, enhanced communication systems, more stringent fire precautions and enhanced signage to support adequate means for escape.

B.3.2.6 Fire strategy

Having a fire strategy in place is key to successfully managing building fire safety. In some cases, reducing the economic loss might add a dimension of fire control beyond life safety and this will be part of the strategy. The safety case and fire strategy are usually integrated and might in the case of a new purpose-designed building be planned from the concept through the whole life use of a building.

B.4 Key fire safety risk factors

The key factors that affect fire safety to be considered in developing or assessing sector-specific frameworks for buildings vary at different stages of the development process.

It is important that individuals are competent to manage fire safety risks related to their discipline, role or task at these different stages. Even where individuals are only involved for a short period or discrete part of a building's development or management, it is important that they understand how their personal activity relates to safety throughout the building lifecycle. This includes awareness of how fire safety forms part of a holistic approach to building safety.

Clauses **B.5**, **B.6** and **B.7** set out common fire safety risks to be considered in order to help inform the development of specific competencies within frameworks or their supporting assessment criteria. It is important that these are considered in a cross-cutting manner as design strategies are just as important to the building manager and first responders as operational management strategies are to the building designer.

It is important to effectively manage fire safety installations and maintenance matters within mixed use units, which could be integral to the building, (and building safety) but potentially under different ownership / management.

B.5 Design, specification and product selection for fire safety

B.5.1 The design of a building is critical to fire safety in two primary ways:

a) For new buildings, the design process enables a holistic approach to fire safety to be integrated throughout all aspects of the building's fabric and services including life safety systems such as emergency lighting, alarm, evacuation systems, standby power and public address. This requires competent designers acting collaboratively to achieve safe standards of performance that can be sustained across the building's lifecycle and effective oversight by building control or standards bodies.

b) For existing buildings, it is important to understand how the original building was designed to be occupied safely; what changes have occurred since it was originally built; and how this has affected the way in which the building is to be operated and maintained to remain safe.

B.5.2 Design includes the selection, specification, coordination and integration of building products to form systems contributing to the overall safety of the building. It is important that all aspects of the buildings are evaluated with respect to their impact on fire safety, including (but not limited to):

a) means of escape – the physical arrangement of staircases, waiting areas, preventing smoke and fire spread, etc so that people can escape the building, aided or unaided, quickly and safely to a safe place in the event of fire;

b) shape, size and layout – particularly in relation to ensuring ease of access and support for firefighting services;

c) materials, products and systems – performance in relation to fire is to be clearly understood; appropriate products are to be used in the right place; assemblies are to work safely as systems and be compatible with other systems; certification and test information is to be understood to inform choice and product changes monitored for system compatibility;

d) passive fire protection and compartmentation – buildings are designed so that the materials and construction selected help to contain a fire and prevent its spread both on the outside and within the building by ensuring effective compartmentation;

e) active fire protection systems and firefighting services are designed to detect and give warning of fire or smoke, actively suppress fire, provide information and services to firefighters to assist fire suppression and control combustion products to enable escape and rescue;

f) human factors relating to fire safety including the causes of fires and human behaviour once alerted to the event of fire; and.

g) day to day operational considerations affecting fire safety or fire strategy and how first responders and firefighters will be able to intervene.

B.5.3 Building regulations and standards typically set out the minimum standards required for life safety objectives. Other objectives, such as property protection or business resilience could be desired. Alternative approaches to delivering fire safety other than those set out in statutory guidance are often acceptable but rely on fire-engineered solutions that require high levels of competence to assess and integrate into the building design. Other commonly adopted building standards include BS 9991 for residential buildings, BS 9999 for non-residential buildings and BB 100 [1] for schools.

B.5.4 Design work is undertaken by a wide range of individuals and businesses all of which are to be competent in ensuring their design delivers fire safety taking into account the performance of any other connected or interrelated part of the building. This includes architects, engineers, interior designers, building surveyors, quantity surveyors and specialist consultants, contractors or subcontractors undertaking design activities. It is useful to consider design work as that defined within with the Construction (Design and Management) Regulations 2015 [2].

B.5.5 There are a number of key fire safety risks recognized during the design stage to be managed including (but not exclusively):

a) individuals undertaking design work without realizing they have the responsibilities of a designer;
b) designers exceeding limits of their own competence by undertaking work for which they are not qualified;
c) failure to adequately address regulatory requirements and take into account good practice recommendations for fire safety;
d) designers relying on assumptions of performance rather than using evidence to assure performance;
e) designers relying overly on the competence of others to identify and resolve fire safety issues in the building's design;
f) failure to accurately record fire safety strategies and key decisions affecting the fire performance of the buildings;
g) failure to properly coordinate design with other designers and to assess holistic performance including resolving complex ownership and management within, for example, mixed-use developments;
h) failure to properly manage waste and storage needs in a way which avoids fire safety being compromised.
i) failure to consider design risks associated with the construction, maintenance use or operation of the building; and
j) failure to undertake proper / sufficient checking of workmanship and quality.

B.5.6 It is important that consideration is therefore given as to what competence is required for any given discipline, role, activity or task. Where limits of an individual's competence is exceeded, it is important that a suitably competent and qualified individual is engaged to contribute in managing the following key aspects of fire safety design:

a) ability to comply with or exceed minimum technical requirements for fire safety;
b) ability to understand the fire performance of materials, products and systems and make effective choices to promote holistic fire safety in the resultant design;
c) ability to coordinate activities with other designers to enable holistic building safety; and
d) the need to manage and maintain records and distribute drawings, schedules, specifications, etc. to maintain the golden thread of information through the building lifecycle.

B.5.7 These considerations are just as critical when undertaking design work for minor alterations or major refurbishment of existing buildings. Competence of designers is important when undertaking this type of work so that they are able to audit how those changes might affect the building's safety, taking into account the original design intent and any other changes which have taken place in the interim.

B.5.8 Competence of designers is important in assessing and managing fire safety risks which arise from interactions at the construction stage, particularly where changes to the design are proposed for cost management purposes. Equally, it is important that designers also recognize where specialist or more competent advice is required in assessing the impact of these changes on building safety and appoint a suitably competent person to assess impacts on fire safety and ratify the amended design.

B.6 Construction works to new or existing buildings

B.6.1 Construction work is highly complex and involves a large number of suppliers, trades, disciplines and organizations to coordinate their activities in order to deliver the intent set out in the design.

B.6.2 The construction phase involves a wide range of individuals and organizations including designers, cost consultants, contractors, subcontractors and regulators, and it is important that all of whom understand their role in maintaining fire safety standards through the building process.

B.6.3 It is recognized that there are critical ways during the design, construction, maintenance or alteration of a building where safety standards can be compromised. These include (but not exclusively):

a) inaccurate, misleading or inadequate information being made available on fire performance of products and systems

b) products being omitted;

c) products being incorrectly specified or poorly installed;

__NOTE__ For example, cavity barriers upside down, fire doors being incorrectly installed with the wrong frames or furniture or in the wrong location, inadequate seals around frames or inadequate number of fixings.

d) products being substituted for poorer performing alternatives which compromise fire safety performance;

e) use of products which hold insufficient or inadequate testing for fire performance purposes, or which have a shorter lifespan than the building requiring future replacement;

f) products being substituted without reviewing impact on holistic fire safety performance, or performance of adjacent, connected or dependent systems;

g) failure to adequately consider performance of components as a system;

h) incorrect or inadequate commissioning of fire safety systems;

i) inadequate or poor management of interfaces between follow-on trades impacting fire safety performance;

j) damage to compartmentation;

__NOTE__ For example, holes made for services without adequate fire stopping or systems during construction or refurbishment or maintenance works compromising fire safety performance.

k) cost-cutting or value engineering exercises being undertaken without adequate reassessment of impacts on fire safety design intent and performance;

l) design work undertaken by individuals who are not competent as designers;

m) re-design or changes to specification being undertaken without proper understanding of original fire safety design intent or which could compromise the fire safety performance of the building as a whole;

n) inadequate quality management and oversight of work quality;

o) multiple levels of sub-contracting affecting ability to effectively communicate requirements;

p) fragmented supply chains impacting ability to manage the golden thread of information through the project lifecycle to completion of work;

q) failure to provide appropriate temporary fire safety and prevention measures;

r) failure to make provision for adequate support for building services; and

s) failure to sequence works properly causing installation / construction problems at a later stage.

B.6.4 In isolation or combination the risks in **B.6.3** can significantly affect overall building safety outcomes. If repeated multiple times over a building's lifecycle, fire safety can become severely compromised.

B.6.5 The risks in **B.6.3** can be mitigated by strong links and effective communication between and within the design and construction phases of projects, with design intent clearly recorded and passed on to the construction team. Wherever possible, it is preferable for buildings to be constructed in line with the original design intent to avoid the risk of reduced fire safety performance arising from re-design during the construction phase. Where changes do occur to layout, materials, products or systems, it is vital that these changes are re-evaluated in terms of any potential impact on fire safety. Where necessary, additional mitigation is to be provided. While changes during construction do not always result in a worse building and might be inconsequential as far as fire safety is concerned, the culture of doing this without proper recording or scrutiny can allow unsafe construction to occur.

B.6.6 Managing competence of site staff, subcontractors and operatives is also essential with work being undertaken by, or under the direct supervision of, competent and qualified individuals who take responsibility for the quality and safety of the work. While some defects in critical fire safety measures can be found during construction or during regulatory audits, there are many elements that are hidden or difficult to check which could have catastrophic consequences if they do not perform as intended.

__NOTE__ For example, cavity barriers and fire stopping or sealing around breaches in compartmentation.

B.6.7 Careful consideration is to be given as to the type and level of competence are required to address and mitigate these risks. This might include:

a) the ability to appoint, check, manage and assure competence of those involved in the construction process;
b) suitable knowledge of construction technology, systems and products and their relevance to achieving the right level of fire safety performance;
c) knowledge of and the ability to execute or manage work to comply with or exceed regulatory requirements;
d) awareness and effective management practices so that fire risks are controlled while work is being undertaken and when work is left in an incomplete state (e.g. overnight);
e) the ability to manage cost and time in a way which does not impact on safety;
f) the ability to effectively plan works so that the right materials and products are available in the right place at the right time;
g) the ability to manage quality of work is correctly installed to the required standard;
h) the ability to identify any emerging fire safety risks and take action to correct underperformance;
i) the ability to manage changes in construction so that they do not compromise fire safety including knowing when to commission re-evaluation against design intent; and
j) the need to hand over fire safety information in a format useable by the client / building owner or operator.

B.7 Management, operation, maintenance and alteration

B.7.1 The management and operation of a building once in occupation is key to maintaining fire safety. At the time of occupation, there is a need for those responsible for the building's management to understand their obligations. Preventing death or serious injury from fire is the cornerstone of good fire safety practice and underpin the key requirements and expectations of the management dutyholder. This includes:

a) duty to take general fire precautions; such as managing waste storage and disposal to reduce the risk of fire spread;
b) risk assessment;
c) how relevant principles of prevention are to be applied;
d) fire safety arrangements;
e) elimination or reduction of risks from dangerous substances;
f) firefighting and fire detection;
g) emergency routes and exits;
h) procedures for serious and imminent danger and for danger areas;
i) additional emergency measures in respect of dangerous substances;
j) maintenance and replacement of components which have exceeded their design lifespan;
k) safety assistance;
l) provision of information to employees;
m) provision of information to employers and the self-employed from outside undertakings;
n) training;
o) cooperation and coordination; and
p) general duties of employees at work.

B.7.2 Typically the work of fire and rescue services is not to identify and rectify building deficiencies that might have occurred during the design and construction phases although it is common for these deficiencies to cause issues which need to be dealt with. Instead, the fire services primary role is to determine whether the building remains safe to be occupied taking these factors into account.

B.7.3 As well as complying with the requirements of fire services, once a building is occupied, there are other regulatory considerations for management which include housing (for instance, use of the Housing Health and Safety Rating System) and environmental health legislation, some of which have some consideration for fire. It is important that the management of a building is aware of:

a) what elements of regulation and legislation apply to the building;
b) the extent to which they are legally responsible;
c) what actions they are to take in order to be compliant;
d) who else is legally responsible (in some cases they might be solely responsible or an element of cooperation and coordination might be necessary as specified in relevant fire safety legislation; and
e) the suitable competence necessary to put plans in place to fulfil the actions identified in a) to d) and then enact them.

B.7.4 There are a number of key operations to be undertaken by competent and qualified individuals to promote continued fire safety. Many of these operations will be required by applicable fire safety legislation, but the following are all considered at the very least to be essential practice:

a) Regular inspection and maintenance of fire safety systems including (but not limited to):
   1) passive protection;

      NOTE 1 *For example, compartmentation, including fire doors, fire-stopping of service penetrations (cables pipes, ducts, dampers) and provision of cavity barriers.*
   2) active fire protection systems, including sprinklers or other means of fire suppression, smoke control and alarm and evacuation alert systems;
   3) facilities for firefighting services; and

      NOTE 2 *For example, wet and dry risers, firefighting lifts and access in the area surrounding the building.*
   4) management of fire risk mitigation, including waste management and inspection of individual dwellings.
b) Engagement with residents including (but not limited to):
   1) developing and managing resident engagement strategies;
   2) listening to and acting on concerns raised;
   3) ensuring competence of any individuals working on the building including consideration of how to manage work commissioned directly by occupants; and
   4) ensuring safety of maintenance and alteration works.
c) Managing safety information and process which includes:
   1) regular review and update of the safety case, building safety strategy and fire strategy;
   2) ensuring the golden thread of building information is maintained through the building lifecycle; and
   3) liaising with regulators and the fire and rescue service as and when necessary.

B.7.5 In particular, consideration of competence requirements that promote awareness (and where necessary higher levels of competence) in relation to the following fire safety risks which commonly arise during occupation might be beneficial:

a) compromise of access for firefighting services to the building;

   NOTE *For example, due to the way in which the building's immediate environment is used and managed.*
b) compromise of fire compartmentation as a result of work undertaken to the building by residents or tradesmen. This includes:
   1) breaching compartment walls to run new services such as cables or pipes; and
   2) alterations to fire doors including their replacement or adjustment/interference with door closers.
c) failure to adequately maintain fire alarm and detection systems;
d) failure to inspect critical safety systems, including but not limited to smoke control systems, firefighting equipment, dry and wet risers and firefighting lifts;
e) failure to manage or control potential sources of fire including through poor waste management and storage or flammable materials left in corridors and on escape routes (e.g. mobility scooters); and
f) failure to check competence of consultants, designers, contractors and installers employed in maintenance and management of the building.

B.7.6 Management procedures are sometimes used as a tool to compensate for building deficiencies or as part of a risk mitigation programme. This is often because it is perceived to be cheaper and easier to introduce than physical risk controls such as compartmentation or fire doors. Understanding the limitations of such measures, and that failures are more likely to occur where fire safety solutions are reliant on the actions of individuals, is an important part of managing building safety.

B.7.7 For the reasons outlined above, it is important that the management of buildings, at all levels, is undertaken by those who are competent to do so.

Annex C (informative)
Structural safety in buildings

COMMENTARY ON ANNEX C

This annex provides an overview of common structural safety considerations in buildings to assist in the development or review of sector-specific competence frameworks.It is not comprehensive but can be used as a starting point to develop an awareness of structural safety relevant to any given discipline, role, function, activity or task. The guidance contained within this annex does not constitute a provision of this BSI Flex.

C.1 General

It is important that design of a building's structure is undertaken by someone who is qualified, has suitable experience and is competent to meet the technical demands of the project. It is recognized that appointing a single engineer to coordinate structural design tasks can further improve safety through a project or building's lifecycle.

C.2 Expectations in terms of structural safety competence

C.2.1 The primary aim for structural safety regimes is to avoid structural failure which can pose a significant threat to life safety both for people within a building and for those in the building's vicinity. It is also important to consider the structural design for temporary loads, temporary conditions and temporary works, particularly where works are being undertaken in occupied buildings. While catastrophic structural failures are rare, their impacts can be severe including multiple loss of life.

C.2.2 Any structural failure can pose a threat to the safety of people within and around the building. This includes localized collapse, instability (e.g. thin unrestrained garden walls or leaning chimneys), the risk of parts of buildings falling off internally (e.g. ceilings) and externally (e.g. copings or elements of cladding systems) and failure of secondary structural elements such as guarding or balustrades which can put people at risk of falling. Serviceability failures such as over-deflection can also pose life-safety threats – for example when a flat roof over deflects causing deep pooling of water on its surface and consequential overloading and roof failure. It also includes hazards that can occur during demolition, such as sudden severing of post-tensioning tendons.

C.2.3 Structural failure might also occur as a result of other events such as:

- fire;
- corrosion;
- erosion;
- timber decay;
- lack of lateral restraint or bracing;
- subsidence;
- strong winds;
- water leaking or flowing below or above ground;
- snow or ice accumulation;
- driving rain;
- chemical reaction;

  NOTE 1 *For example, high alumina cement concrete, particularly if exposed to dampness.*
- undermining;

  NOTE 2 *For example, by excavating close to a building to a depth greater than its foundations - undermining does not necessarily mean excavation below a building.*
- removal of seemingly innocuous loadbearing elements;

  NOTE 3 *For example, load-bearing timber framed partitions or diagonal bracing members.*
- weather; or
- vehicles colliding with the building.

C.2.4 Risks can be reduced by increasing the robustness of the structural solution in new construction or where buildings are altered. Buildings are to be designed, inspected and maintained so that the risk of structural failure from events as described in **C.2.3** is recognized and minimized. Where such events do occur, the likely performance of the building is to be understood so that steps can be taken to mitigate subsequent risks.
For instance:

a) knowing how long the structure of a building will remain stable in the event of a fire (which might require specialist advice from fire engineers) will enable fire and rescue services to gauge how safe it is for residents or firefighters to remain within a building; and

b) understanding that when the structure has been affected, e.g. by a car colliding with a structural column in a car park, the building manager knows how to commission specialist assessment of the extent of any damage.

C.2.5 The design, manufacture, erection and assembly of structural systems, including inspections of the structure, site supervision and independent scrutiny of construction require high levels of competence, often in very specialized areas of activity. It is important that, given the many risks associated with structural failure, the undertaking of structural fabrication, design, installation, inspection and acceptance of work is reserved for individuals whose competence is assured.

C.2.6 However, there are many other roles in the design, construction and management of buildings which can impact on structural safety during its operation, including actions by residents and users of buildings. It is important that there is a common understanding amongst non-structural specialists of how their role relates to ensuring and maintaining structural safety.

C.2.7 It is also important that people are aware of how structural design, fabrication, installation or maintenance relate to other aspects of building safety including, but not limited to, fire safety. It is particularly important to recognize that unauthorized modifications to a building either during construction or when in use can create severe risks and that all modifications are reviewed and approved by a suitably competent person.

C.3 Key risks associated with structural safety

C.3.1 Structural failures are generally well recorded, particularly where there has been a risk to life safety, actual harm or loss of life. Failures are subject to evaluation and review, and it is generally accepted that the main cause of structural failure fall into six main categories:

a) where the structure is not robust enough or stable enough to withstand the loads that act on it – this can be as a result of design or fabrication failures, or both;

b) where the quality of construction is inadequate including failure to adhere to structural design requirements, improper or erroneous use of materials or poor-quality workmanship and supervision;

c) where the materials used are defective;

NOTE 1 *For example, where an error in manufacturing quality or damage in transit affect structural performance.*

d) where inferior materials are substituted during the procurement or construction process;

e) where possible but unlikely problems in use are not fully accounted for in the design of the structure resulting in lack of resilience in real world conditions; and

NOTE 2 *For example, impact by a vehicle, flooding or an explosion.*

f) where the structure is subject to failure due to fatigue or corrosion – this includes the structure being overstressed due to movement and exposure to conditions (such as water penetration) which can cause decay.

C.3.2 It is important to identify interactions with potential structural failure and require suitable competence to mitigate these risks. This includes:

a) Potential risk of explosion which can cause localized structural failure. This includes storage of fuel or explosive materials (such as LPG gas cannisters); careful design, installation and maintenance of gas supplies; and management of processes which could generate an explosive atmosphere (e.g. where dust is generated).

b) Ensuring adequate fixing and support design including for external cladding systems, taking into account system requirements, height and exposure. Inspection and management regimes for critical fixings are usually required to enable continued safety.

C.4 Structural characteristics of higher-risk buildings

C.4.1 The way in which higher-risk buildings have been defined is explained in **B.3.2**. Typically, these are taller or larger buildings, or buildings where occupancy or use increase risk to occupants. They will normally contain large numbers of people on a continual basis such as residential buildings or an occasional basis such as stadia.

C.4.2 The structural characteristics of the building will largely depend on the:

a) location in which it is built including ground conditions (geology) and exposure to the elements (to wind and weather) and proximity to flood plains;

b) likely loads that will be applied to the building during the construction process and resulting from its use; and/or

c) technologies used in its construction taking context and use into account.

C.4.3 Structural characteristics include:

a) foundations – the elements of structure which transfer load from the superstructure to the ground;

b) superstructure or primary structure – the frame, load-bearing system or other fundamental supports of the building; and

c) structural elements and fixings connecting load-bearing elements together e.g. fixing for cladding systems, windows, guarding and balustrades.

C.4.4 There are many different technologies which can be used to fulfil these roles, a number of which are often combined. This includes, but is not limited to:

- in situ concrete;
- pre-cast concrete;
- post tensioned concrete;
- composite reinforced in-situ concrete;
- steel decking;
- steel beams;
- hot rolled steelwork;
- cold rolled steelwork;
- aluminium;
- structural timber systems; and
- masonry (brick or block) structures.

C.4.5 A building's structure is to be designed to take into account conditions that can exist in more extreme circumstances, e.g.in the event of fire or under extreme load, (for example in unusually high wind conditions). This can impact on durability depending on which of these construction technologies are adopted. A competent designer will include combinations of these loads, and the associated risks, when devising the safety case (typically at an early stage in the design process) and in assessing structural performance.

C.4.6 Understanding how these different structural systems age, their vulnerability to deterioration over time (e.g. reaction to fire or corrosion resulting from water ingress in combination with concrete carbonation or the presence of chlorides in the concrete,) and how they are to be inspected and maintained are critical to maintaining building safety. The ability to inspect all parts of a structure which are subject to weather effects is part of a good design.

C.4.7 Consideration therefore is to be given to the minimum levels of competence in the following respects:

a) ability to identify different structural systems;

b) awareness of basic characteristics of different structural systems in terms of performance in response to fire, water penetration and decay;

c) awareness of how own role interacts or can impact on structural safety;

d) awareness of events which can affect structural safety and how to respond to those events; and

e) how and when to commission and procure competent expert advice or assessment to maintain structural safety.

C.5 Design and specification for structural safety

C.5.1 Regulations typically require that buildings are designed in accordance with current design codes (or the design codes applicable at the time they were built). These design codes include a range of safety factors to ensure that there is sufficient redundancy in the design to deal with most likely events. However, this is only the case where the design and construction is undertaken by suitable competent people, and the construction work is undertaken in accordance with that design.

C.5.2 Compliance with regulations and their supporting statutory guidance normally reflect the minimum requirements for achieving structural safety.

C.5.3 Since 1968, structural design requirements in regulation have progressively integrated requirements to address the risk of major structural failure in the form of progressive or disproportionate collapse. This means the failure of one part of a building's structure does not lead to other parts of the structure collapsing. A structure properly designed and constructed in line with the codes of practice cited in national building regulations and their supporting statutory guidance can address these issues.

C.5.4 Structural safety requires competence of the engineers who are designing and fabricating the structure. Structural design is becoming increasingly complex and frequently uses advanced analytical techniques to improve structural efficiency.

C.5.5 At the same time, many elements of detailed structural design are undertaken by specialist subcontractors, including connection details of foundations and structural frames, design of temporary works, façade engineering and the design and specification of fixtures for safety critical elements such as guarding, balustrades and cladding systems. An important safety issue is for the Principal Contractor to check that there are clear responsibilities and lines of communication for all those in the supply chain and that subcontractors are suitably competent to undertake design work. Appointing an independent lead or checking engineer with general oversight of engineering work can help to improve building safety outcomes.

C.5.6 While it is critical that major elements of structure are designed properly, a number of structural failures with life safety implications have been identified relating to secondary structural elements and even fixings for other elements of building systems. This includes:

a) failure to properly design and specify fixings leading to elements of structure or building fabric falling from height
b) use of incorrect glazing in glazed balustrade systems; and
c) failure to correctly design fixings for rendered and rainscreen cladding systems taking into account height and likely wind loads.

NOTE *Further examples of deficiencies and failures can be found on the CROSS website (www.structural-safety.org).*

C.5.7 Structural design is an integrated part of the building as a system and is to be coordinated with:

a) fire safety strategies so that structural integrity is maintained in the event of a fire to enable people to evacuate and to support emergency operations;
b) strategies to protect structural elements of the building (e.g. encasement and compartmentation) to enable the above;
c) measures to avoid corrosion or decay – this includes assessing designs for interstitial condensation within the structural layer; and
d) service layouts to avoid buildability issues which might reduce margins of safety, e.g. where structural elements are penetrated to resolve co-ordination issues.

C.5.8 Consideration of the level and type of competence required to directly undertake structural design includes:

a) understanding limits of competence in undertaking structural design tasks or work; associated with structural safety;
b) ability to identify where specialist advice is needed;
c) ability to identify interfaces between structural design and other disciplines relevant to building safety, e.g. fire safety or managing condensation risk; and
d) ability to procure and manage competence of others appointed to undertake structural design work.

C.6 Construction

C.6.1 It is important that the construction phase of work, whether new build, extension or maintenance focuses on delivering structural solutions that perform in line with the structural design. As many elements of design are undertaken by specialist subcontractors during the construction period it is vital that:

a) contracting organizations are capable of assessing and managing subcontractor's competence to undertake design work and that there is a clear chain of communications setting out responsibilities;
b) contracting organizations are competent in making sure that any changes to structural design are referenced back to a competent structural designer; and the implications of those changes are properly evaluated for both structural and fire safety, e.g. if an additional story is added to a design, the roofing steelwork will become flooring steelwork and require additional fire protection; and
c) temporary works are designed by competent persons and suitably managed to maintain structural integrity during the construction phase.

C.6.2 Managing quality of fabrication, installation and construction work is also critical. It is important that contracting organizations and the people they employ are competent to:

a) review and coordinate structural design information developed during the construction phase;
b) review proposals for supervision on site;

c) check quality and suitability of materials (being wary of substitutions) arriving and being used on site to meet structural safety requirements;
d) establish, programme and manage a programme of site inspections to review quality of installation at critical phases, e.g. compliance of reinforcement prior to pouring concrete;
e) undertake suitable quality testing as and when required, e.g. of weld strengths or concrete strength to achieve compliance with specifications;
f) manage variations in structural design or installation by referring changes to the structural designers so that structural safety is not compromised; and
g) Independent scrutiny of construction, for example by the structural designers or a suitably experienced independent clerk of works will reduce the risk of the structure being constructed incorrectly and will help ensure builders execute work competently.

C.6.3 It is important that accurate records, including photographs, are retained during construction to be passed onto building operators for management purposes.

C.7 Management, operation, maintenance, alteration and demolition

C.7.1 Buildings have a potentially long life and can certainly be expected to last at least 60 years. For buildings to remain structurally safe over this time period requires:

a) periodic inspection to understand the condition of the building structure and identify any works required;
b) maintenance and remedial work to address any issues which might lead to damage to the structure;
c) careful management of change of use, alteration, extension or modifications to the building so that structural integrity is not compromised over time; and
d) retention of information relevant to the building structural safety including through use of digital systems and building information management systems where appropriate.

C.7.2 Where significant alterations or extensions to a building are undertaken, it is important that these are carried out with the same care in design and construction expected of new building work.

C.7.3 It is also important that care is taken with minor alterations, particularly those which involve creating holes or routes within the building (for instance, installing new cables) or which could impact on fire protection or water tightness or load carrying capacity of a member (e.g. cutting deep notches for services in floor joists). Cumulative small changes can result in more serious damage to the building structure, e.g. holes drilled through reinforced concrete can sever reinforcement as well as allow water to enter; adding elements without checking loading capacity of the original structure or increasing height of structures without considering lateral stability can all lead to failure.

C.7.4 The building's structure is to be understood as being subject to change over time. Many forms of structure are vulnerable to corrosion or decay, particularly if water (including interstitial condensation) is allowed to enter into the structural layers. Structural elements can also suffer from fatigue, although this more commonly affects secondary or ancillary elements such as brise soleil.

C.7.5 Periodic inspection of the building structure by a competent person is therefore critical with frequency of inspection based on risk, e.g. based on the condition of the structure, as well as in response to incidents which could affect structural safety. These include:

a) where a structural element fails which might indicate wider structural issues, e.g. a piece of cladding detaching and falling from the building;
b) evidence of structural movement such as severe cracking or sagging of members;
c) collision or physical event which might cause damage to the building structure, e.g. collision of a car with a column or structural wall;
d) where there is evidence of likely water penetration e.g. localized flooding, water from firefighting, evidence of failure in water tightness of cladding systems, evidence of extensive damp or mould; and
e) damage from an extreme environmental effect such as very high wind.

C.7.6 Structural inspection can be undertaken by a variety of means. Drone technology now enables extensive visual inspection of the exterior of buildings reducing the need for costly scaffolding or access equipment. This can be combined with the use of thermal imaging cameras to detect any gaps in insulation which could, for example, cause condensation issues or indicate water ingress into cladding systems.

C.7.7 Often it will be necessary to seek specialist advice on structural issues to understand whether there is material risk requiring mitigation. It is recommended that buildings owners and managers enter into flexible arrangements with suitably competent persons such that inspections and advice can be obtained in a timely manner.

C.7.8 Individuals managing or responsible for operating buildings might have to consider how to manage competence of key individuals in relation to:

a) knowledge and ability to discuss the fundamental nature of the building's structural design;
b) awareness and ability to respond and manage risks arising from building work being undertaken or events which could impact on structural integrity;
c) requirements for and ability to manage or obtain assurance of competence of individuals undertaking work which could impact on structural safety;
d) awareness and ability to plan and manage suitable inspection regimes to maintain structural integrity and safety; and
e) awareness and ability to respond to resident concerns relating to structural condition.

C.7.9 For individuals undertaking work on higher-risk buildings, the following considerations may be particularly relevant:

a) ensuring competence to undertake design work including using competent persons for design of fixings to all structural elements;
b) awareness of potential interactions and impacts on structural integrity of work to be undertaken;
c) competence to manage quality of design, fabrication and installation; and
d) ability to identify risks, raise concerns and take mitigating actions in relation to structural safety.

Annex D (informative)
Public health and public safety in buildings

COMMENTARY ON ANNEX D

This annex provides an overview of common public health and public safety considerations in buildings to assist in the development or review of sector-specific competence frameworks.It is not comprehensive but can be used as a starting point to develop an awareness of public health and public safety relevant to any given discipline, role, function, activity or task. The guidance contained within this annex does not constitute a provision of this BSI Flex.

D.1 General

Public health considerations include the primary risks arising from the environment which people occupy which might give rise to ill health, while public safety relates to risks that might give rise to injury.

D.2 Expectations in terms of public health and public safety competence

D.2.1 Fire and structural safety risks are regarded as being the most likely types of risk to give rise to catastrophic failure where a single event can result in serious loss of life. However, fire and structural safety are not the only factors to be considered in ensuring buildings are safe. There are also a wider range of risks relevant to buildings, including higher-risk buildings, to be managed.

D.2.2 It is not that buildings classified as higher-risk are inherently more dangerous – this will not be the case where risks to public health and public safety are properly managed. It is important however to be aware of the way in which the nature of higher-risk buildings can make the impact of these risks more severe or indicate that a problem found in one location might be found in many other locations (due to the repetitive nature of design in multi-story buildings). In particular, higher-risk buildings tend to be tall and/or accommodate a significant number of people in a single location.

D.2.3 Relevant risk factors in buildings include:

a) Height and scale – a problem in a taller or larger building is more likely to affect a significant number of people, and as height increases the risks from a number of public safety factors might also increase e.g. managing flue gas emission from combustion appliances (such as boilers) is much more complex in a tall building than in a two-storey house.

b) Shared services – where multiple dwellings share building services and systems, a single failure can affect many more people, e.g. a shared water supply system can support the development of pathogens significant to public health (such as Legionnaires' disease) if not properly managed, or shared flues can pass carbon monoxide from one dwelling to another.

c) Shared spaces – communal areas within buildings can create different risks. In addition, with a number of occupants accessing shared services and common areas, there are more opportunities for the actions of one occupant to create increased risks for others. There might also be differing attitudes to risk or a wider range of risk as a result of vulnerability of the occupants.

D.2.4 Subclause **D.3** sets out common types of public health and public safety risk. It is important to consider where activities relevant to any discipline, role or task could interface with these (or any other risks that are identified) and require suitable awareness of them as well as identifying what level of competence is required to mitigate those risks. This includes, where relevant:

a) knowledge and ability to comply with or exceed requirements of relevant building regulations, standards and supporting statutory guidance;

b) knowledge and ability to comply with other legislation and follow relevant guidance appropriately;

c) awareness of interface of activities with other potential sources of public safety risk and how to mitigate these; and

d) awareness of need to identify and escalate risks where necessary.

D.3 Key public health and public safety risks

D.3.1 Radon, methane and site contaminants

D.3.1.1 The ground on which a building stands can in itself be a source of risk to be managed. There are a wide range of solid, liquid or gaseous contaminants typically resulting from:

a) contamination; and

NOTE 1 *For example, where a site has had previous industrial use including factories and land used for waste landfill; or in rural areas where land has been exposed to pesticides, fertilizers and oil spill.*

b) geological factors.

NOTE 2 *Including naturally occurring heavy metals such as cadmium and arsenic; and naturally occurring gases which can enter the building such as methane (which poses a risk of explosion and fire), carbon dioxide or radon (which poses a long-term life safety risk, and which could cause cancer).*

D.3.1.2 For new works or extensions, suitable desktop and site surveys are to be undertaken to identify, develop risk management strategies and mitigate risks from contamination – this also usually involves engagement with a building control body, the local planning authority and the environment agency.

D.3.1.3 These risks need to be identified and where necessary remediation measures put in place which can include containment or removal of contaminated soil. Buildings might also need to be designed and built with barriers to prevent gas or liquids from entering the building in combination with creation of ventilation pathways with stack effect to remove ground gas; or in the case of radon, use of active extraction systems such as sump pumps.

D.3.1.4 Extensive guidance on managing these risks is available to support designers and contractors and anyone undertaking design or construction works to be competent to identify where action is required including seeking suitable specialist advice.

D.3.1.5 It is important that building managers and owners are aware of these risks; how they relate to the buildings they manage, and have in place the right inspection and maintenance requirements so that mitigation measures remain effective once the building is occupied.

D.3.2 Asbestos

D.3.2.1 The use of asbestos has been banned since 1999 but is frequently found in various forms in buildings erected or altered prior to that date and can still be present in more recent construction. Management and removal of asbestos are carefully regulated so that building users and workers are kept safe. Legal duties (under the 1974 Health and Safety at Work Act and the Control of Asbestos Regulations) on those persons in control of buildings and those working on premises are designed so that risks from asbestos in situ are minimized.

D.3.2.2 Essential practice in managing asbestos safely includes recording the location of all asbestos on the basis that it only remains in place if it is maintained in good condition, not vulnerable to damage and is regularly inspected where accessible. Effective management also involves sealing off any asbestos that is not accessible for inspection with the seals inspected regularly. It is important that all those engaged in mainteance or works to existing buildings are aware of asbestos risk and mitigating actions where asbestos containing materials are found or known to exist.

D.3.2.3 Competent and appropriately trained persons are the only individuals suitable to carry out works related to asbestos and require access to asbestos location information before work starts. Written permits to work are recommended. In particular, it is important that:

a) designers and building managers are familiar with asbestos risks and how to identify and manage asbestos-containing material;

NOTE *It is recommended that building managers attend a suitable training course on duty to manage asbestos and refresher and update courses on a regular basis.*

b) workers know-how to recognize suspect materials and the next steps to take to minimize risk to themselves and others;

c) specialists in higher-risk work such as remediation or removal of asbestos have the appropriate higher competence levels to remain legally compliant; and

d) where asbestos was installed as a fire/heat protection, consideration is given to replacing this protection with material delivering the same or better protection if the asbestos is to be removed.

D.3.3 Ventilation, damp and moisture

D.3.3.1 It is important that buildings are designed and built so that:

a) there is adequate ventilation to maintain healthy indoor air quality;

b) there is provision to purge ventilate where there is an urgent need to remove noxious fumes or gases;
c) the habitable spaces are not subject to damp; and
d) moisture does not penetrate the building in a way which can damage the structure or fabric of the building or contribute to damp forming or unhealthy indoor air quality.

D.3.3.2 Poor ventilation and moisture ingress often lead to poor air quality or the formation of damp. Damp problems are often the result of condensation within the fabric of the building (interstitial condensation), resulting from poor design or construction practice or from poor installation of energy efficiency measures.

D.3.3.3 Poor indoor air quality and damp can have serious health implications including contributing to premature death. Treatment of ill health caused or exacerbated by poor indoor air quality and damp is a significant long-term burden and cost to the health service and welfare system. Ensuring that habitable accommodation has adequate air quality and is not subject to moisture ingress is therefore a key area of competence for designers; persons constructing, installing or commissioning relevant elements of a building; and an area where building managers have to be competent in understanding, identifying and responding appropriately to indications of air quality issues or damp.

D.3.3.4 Minimum standards to address these issues are set out in building regulations, codes and standards and associated statutory guidance but consideration is to be given to site-specific environmental factors such as security (fear of opening windows) and pollution (proximity to busy roads) which can seriously affect ventilation and require additional mitigation.

D.3.3.5 Moisture within the fabric of the building can be indicative of water penetration from failed cladding, failed or blocked gutters and downpipes or compromised building watertightness due, for example, to failed parapets and copings. Damaged membranes at foundation level allowing rising damp can contribute not only to damp, but damage to the building's structure with the potential for more significant structural failure.

D.3.4 Overheating and heating failure

D.3.4.1 Buildings are also potentially very dangerous if they are prone to overheating, or if people are exposed to long periods of unhealthy cold temperatures. In both cases, more vulnerable people (the very young, older people and people with underlying health conditions) are likely to be more affected, including being at risk of premature death.

D.3.4.2 Overheating risk to health occurs where properties are subject to sustained periods where temperatures do not allow the human body to re-stabilize temperature. Overheating risk varies from occupant to occupant and dwelling to dwelling but most frequent causes include lack of or inadequate ventilation; excessive solar gain from windows on exposed elevations; excessive heat gain from building services; lack of thermal mass to absorb heat or inability to take advantage of overnight cooling.

D.3.4.3 Higher-risk buildings are potentially more vulnerable to overheating because they are often tall buildings with single aspect flats which do not benefit from cross ventilation, but which might be exposed to a lot of heat gain from the sun; in some cases, they are higher-risk due to their occupants being more vulnerable, e.g. care homes.

D.3.4.4 Solutions to overheating at the design stage include undertaking suitable overheating analysis; introducing mitigating measures such as external solar shading (where that is permitted by current regulations) or heat reflective glazing; reducing glazed areas on exposed elevations; increasing ventilation rates and using stack effect or insulating internal building services to reduce heat gain.

D.3.4.5 Dealing with overheating in occupation might involve introducing control measures as described in **D.3.4.4** where this is possible; addressing barriers to use of ventilation; or provision of comfort cooling as a management procedure. Ultimately, very vulnerable persons might have to be moved to alternative accommodation.

D.3.4.6 Where heating systems fail, are not working properly or are inadequate, there is a serious risk to health from people spending extended periods of time living with internal temperatures below 13°c. This is recognized as leading to significantly increased risk of cardio vascular and respiratory illness and premature death.

D.3.4.7 Building designers, managers and maintainers are to have suitable competence in relation to avoiding overheating and excess cold where this relates to the activities they undertake.

D.3.5 Water supply, hot water storage, drainage systems and waste

D.3.5.1 It is important that water supply and drainage systems in all buildings are designed, installed and maintained to protect public health. Considerations for higher-risk buildings tend to be considerably more complex than systems in smaller or lower buildings. As these services are shared, problems that occur can affect a large number of people, including risk of bacteriological infections such as Legionella or other water-borne pathogens. Undertaking design, installation and maintenance of these systems requires suitably competent people. In high-rise buildings there are also significant risks arising from the pressures generated in hydraulic systems, requiring specific competences of designers, installers and those who maintain or work on those systems.

D.3.5.2 It is important that fresh-water supplies provide water that is healthy to drink and does not become contaminated. It is also important that water supply systems have adequate pressure to reach higher up parts of buildings, and that there are no leaks which could contribute to damp problems or damage the building structure and fabric. Adequate water pressure is also required in charged/full wet risers where these are installed.

D.3.5.3 Water systems are understood to pose a number of risks to health and safety. It is important that:

a) hot-water cylinders are maintained to be safe, particularly where they are pressurized cylinders;
b) systems and distribution pipework are able to withstand both the operating pressure and the temperature of hot water they carry to avoid deformation, leakage or failure;
c) water systems, including cisterns and tanks within dwellings, are designed and installed to resist likely temperatures and pressures and are adequately supported;
d) hot-water outlets (taps) in critical locations (such as baths in private dwellings) are installed so that temperatures at point of use are not dangerous and risk scalding.
e) water systems are maintained at suitable temperatures and kept clean (e.g. shower heads) to reduce the risk of legionella and other pathogens; and
f) these factors are understood and managed at design, construction and occupation stages.

D.3.5.4 It is important that drainage systems include grey water systems (from sinks and appliances); foul water systems (from toilets, etc.), and rainwater recovery systems work so that waste water is disposed of safely. Grey water and foul water systems pose potentially serious public health risk including spreading serious disease if they are defective.

D.3.5.5 As drainage systems are shared within tall or larger residential buildings, if they become damaged or blocked they can affect a large number of people and put them at risk of living in unsanitary conditions.

D.3.5.6 Drainage systems are to be watertight and maintain air tightness in critical locations (typically referred to as traps) to prevent foul air re-entering dwellings – this includes the potential for viruses to spread between dwellings. Drainage of foul and grey water is typically via vertical pipework referred to as 'stacks' which require air intake either at the top or by admittance valves adjacent to sanitary appliances to prevent suction in the pipework.

D.3.5.7 In taller buildings, care is to be taken in avoiding too many bends or sweeps in vertical pipework, and consideration has to be given to much higher pressure and velocity of discharge into the pipe at height. It is advisable to introduce higher levels of acoustic protection around shared stack pipes, particularly at low levels within the building.

D.3.5.8 The design of grey water and foul water systems require adequate access for cleaning, rodding and removal of blockages. They also require regular inspection and maintenance both above ground (within the building) and below ground (sewers) as required.

D.3.5.9 Storage and disposal of solid waste (rubbish) in all buildings but particularly in higher-risk buildings is also to be given serious consideration. A build-up of waste represents a potential source of ignition and can compromise both escape routes, compartmentation and access for firefighting services. Poor waste management can also create public health risks, including promoting spread of disease and providing a habitat for vermin.

D.3.6 Gas supply, combustion devices and carbon monoxide

D.3.6.1 Many individual dwellings have gas, oil or LPG boilers. While some higher-risk buildings have communal heating systems, it is also common for individual flats or dwellings to have their own boilers, many of which are connected to gas supplies.

D.3.6.2 Gas systems are to be fitted in accordance with relevant gas fitting regulations so that pipework is suitably robust (not easily damaged), located to avoid the risk of gas building up in voids (which can give rise to explosions if ignited) but also located outside of critical protected escape routes. It is important that voids have appropriate access points for inspection and maintenance and that pipework is also suitably resistant to decay.

D.3.6.3 Boilers require regular maintenance and inspection to remain safe and the waste gas from combustion has to be discharged safely. In some tall buildings this is by way of internal shared ducts, in other buildings direct to the outside. It is important that combustion gases are not expelled in a location where they can re-enter the building; and in shared ducts there is sufficient buoyancy for waste gases to rise to the outside. It is also essential that shared duct systems are properly commissioned and then regularly maintained so that combustion gases cannot be transferred from one dwelling to another. This can lead to carbon monoxide and other toxic gases entering dwellings and can cause death by asphyxiation. Where such leakage occurs, it is generally an ongoing effect and not an isolated single occurrence and can therefore lead to longer term exposure to carbon monoxide with associated health impairment.

D.3.6.4 Boilers and cookers also require sufficient oxygen supply to avoid partial combustion which can give rise to release of excessive carbon dioxide and highly toxic carbon monoxide. Carbon monoxide detectors might be required adjacent to some types of boilers/combustion devices and require regular checking. It is critical that all boiler flues and inlets are installed by competent persons so that there is adequate oxygen supply and to avoid any risk of combustion gases leaking back into the property. It is also essential that all combustion appliances are regularly serviced and maintained by a competent person. Building safety managers will have to put in place management systems to ensure that these tasks are undertaken and that any remedial actions required are carried out without delay.

D.3.6.5 Wherever gas installation takes place, it is important that the work does not breach fire compartmentation, with any penetrations of fire compartments made good using appropriate techniques and materials to meet the correct fire rating for that element. Extraction systems (including cooking extraction) which pass through multiple compartments represent a particular hazard and require suitable containment as well as regular cleaning and maintenance regimes.

D.3.7 Electrical safety and lightning protection

D.3.7.1 Electricity can kill or severely injure individuals and also poses a serious risk to building safety as a potential cause of fire, including as a result of the building being struck by lightning. It is important that electrical work is always carried out by suitably qualified and competent persons. Inspection and testing by a suitably qualified and competent electrician is important to manage safety, prior to occupation of a new building or following work to an existing building.

D.3.7.2 Inspection and testing by a suitably qualified and competent electrician is also vital in existing buildings and for existing electrical systems so that any deterioration and faults are identified and rectified before serious problems can occur. This includes switchgear, distribution boards, cables, emergency lighting and other parts of an installation being assessed and replaced as and when necessary.

D.3.7.3 Higher-risk and multi-storey buildings tend to contain vertical risers with high voltage and high amperage/current distribution boards. It is important that access to these risers is strictly controlled, and the fire compartmentation of the riser and of the cable management systems maintained to prevent it providing a vertical path for fire within the building.

D.3.7.4 Most large and higher-risk buildings, including mixed use developments, often include complex life safety systems such as pressurization, smoke ventilation and firefighting lifts, which require dual supplies, standby generator backup and changeover switchgear systems. These systems require a high level of specific electrotechnical knowledge, skills and experience to enable correct operation in the event of an emergency. It is important that they are installed, inspected, tested and/or maintained only by a suitably qualified and competent electrician working for a competent organization.

D.3.7.5 Many buildings will also require lightning protection systems designed to protect occupants and the building. Reducing risks to occupants involves isolating step and touch risks in the event of a lightning strike and providing signage identifying any exposed areas (such as roof or unshielded ground areas) to be evacuated during thunderstorms. It is important that the lightning protection itself is designed by a suitably competent person and takes account of the need for separation from other conductive materials, adequate surge protection to electrical installations and suitable bonding of exposed metallic structures such as external cladding or balcony balustrades (particularly in buildings over 60 m in height).

NOTE *Detailed information about registration/ certification requirements for accredited electrical enterprises and the qualifications and experience requirements for the individuals whom they employ is set out in the Electrotechnical Assessment Specification document, available from the Institution of Engineering and Technology (IET) website: https://electrical.theiet.org/bs-7671/building-regulations/electrotechnical-assessment-specification/*

D.3.8 Guarding, balustrades, staircases and glazing safety

D.3.8.1 Slips, trips and falls represent the most frequent source of injury or serious injury in buildings. Staircases are a particular source of risk, but in taller buildings any slip, trip or fall can prove fatal if there is inadequate protection against falls.

D.3.8.2 Guidance on safe staircase design is provided in building regulations, and relevant British Standards codes of practice. Designers can minimise risks through careful design and specificaiton. The key features are:

a) adequate and even rise and going (tread) of the stair;
b) a reasonable pitch (steepness);
c) nosings at the front edge of stairs which prevent the foot from slipping and provide a visual contrast to help define the edge of each step;
d) selection of suitable materials to minimize risk of slips[1];
e) adequate handrail to allow persons to regain control and arrest a fall;
f) adequate guarding to prevent falling over the side of a stair;
g) adequate headroom;
h) breaks in long flights of stairs to enable people to arrest their fall; and
i) lighting that enables people to see steps and landings clearly.

D.3.8.3 Staircases require maintenance and periodic inspection. The risk of pedestrian slips, trips and falls is an important factor to be considered when designing and refurbishing buildings, as well as when planning activities within existing buildings. The choice of floor surface, as well as the design of entrances, stairs, storage and lighting can have a significant influence on the risk of slips, trips and falls. Inconsistent (irregular) stair dimensions create a signficant risk of misstep and fall.

D.3.8.4 It is important that wherever reasonably practicable, floor surfaces are free from defects, obstructions and substances that could pose a risk of slips, trips and falls. Suitable installation and maintenance of floor surfaces and the provision of adequate storage can help keep walkways clear of obstructions and other trip hazards. A pedestrian's toe clearance can be lower than 10 mm during normal walking gait and so even small obstructions and/ or changes in level can present a trip hazard. Where reasonably practicable, it is important that potential trip hazards are removed.However, in situations where it is not reasonably practicable to remove the trip hazard, pro-active measures are necessary to mitigate the risk that they pose. Mitigation measures might include redirecting pedestrian traffic to avoid the trip hazard or making the trip hazard easily noticeable by providing good lighting and using contrasting colours to highlight the trip hazard. When assessing the risk and deciding on the most appropriate interventions, it is important to consider the type of pedestrian activity within the area and take into account the needs of people with imapired vision, mobility or cognitive function. For example, making the trip hazard more noticeable might not be sufficient if pedestrians are carrying objects that could obscure/block their view.

D.3.8.5 Changes in level cannot be avoided on stairs, but measures can still be taken to manage the risk. Inconsistent stair dimensions has been shown to increase the risk of falls and so it is important to make sure the rise and going (height and depth) of each tread is consistent throughout the entire flight. National building regulations provide detailed specifications for minimum standards of safety in stair design. Typically, this includes recognition that good lighting and the installation of non-slip stair nosings in a colour that contrasts with the treads and adjacent floor surfaces will significantly reduce the risk of missteps and the provision of suitable and sufficient handrails will help to arrest any falls.

[1] More information at https://www.hse.gov.uk/slips/architects.htm

D.3.8.6 Floor surfaces do not tend to be slippery when they are clean and dry, but some floors can become very slippery in the presence of small amounts of surface contamination. The design of the building (e.g. the installation of canopies over entrances) and careful planning of the activities within the building can help to reduce the likelihood of floor surface contamination. However, in some environments it might not be reasonably practicable to keep the floor surface clean and dry at all times. It is therefore important to assess the likelihood of the surface becoming contaminated and in areas that are considered susceptible to contamination (e.g. at entrances) install a suitable slip resistant floor surface.

D.3.8.7 Guarding and balustrades to balconies, walkways and external spaces are critical to safety, particularly in taller buildings. Guidance on safe design of balustrades and guarding is provided in building regulations and relevant British Standard codes of practice.

D.3.8.8 Balustrades are to be capable of resisting considerable weight by being firmly fixed back to the building's structure, and strong enough to prevent failure. Effective balustrades and guarding will be high enough to prevent someone falling over them easily (with the top rail above the typical centre of gravity) and designed so as not to be easily climbable by children.

D.3.8.9 Where glazed balustrades are used care is to be taken so that if the glazing fails there is still adequate protection from falling. It is important that replacement glazing is carefully specified to ensure it is suitable in these locations and meets structural loading requirements.

D.3.8.10 Glazing throughout the building can also pose a danger, particularly in common parts where people congregate. The main risks are from colliding with the glass causing it to break and cause injury; and broken glass or glazing units falling from height. Requirements are set out in building regulations and codes for areas of glazing to be:

- guarded to prevent collision;
- for manifestation to make glazing more visible to reduce the risk of collision; and
- specified so as to be resistant to breaking or to break safely to help reduce the likelihood or severity of injury.

D.3.8.11 It is important that glazing installation is designed and installed so as to be structurally sound, including design of fixings.

D.3.8.12 Correct specification is critical in undertaking any works to replace glazing so that the right type of safety glass is used – as well as, for example, toughened or laminated glass, this can include fire rated glazing which is critical to longer term fire safety in some locations. Where glass breaks, expert advice is necessary regarding how to mitigate risk (e.g. of shards falling from height) until replacement can be undertaken. Similarly, assessing the condition and risks associated with glazing installation, maintenance and replacement requires specialist knowledge to avoid mitigation of one risk creating new (consequential) risks.

D.3.9 Summary

D.3.9.1 Design and installation of many aspects of buildings have life safety implications, and particularly for higher-risk and more complex buildings that require a high level of competence to make sure that the building is safe. Some tasks will require higher levels of competence than others so it it vital that qualifaciton and assessment frameworks reflect this variability in ability. This is equally true when undertaking any work once the building is occupied, whether that is modification, maintenance or replacement. Competence will have to evolve in response to technological innovation and as regulatory requirements and standards change.

D.3.9.2 It is critical that designers, contractors and building managers acknowledge the limits of their competence and seek specialist advice or assistance whenever necessary given the wide range of competence required to address all of the possible public health and public safety issues.

D.3.9.3 It is particularly important that building managers are diligent in ensuring the competence of those who carry out work to the building once it is occupied, taking into account how this affects safety over time. In doing so, it is important that they proactively consider the wider range of potential impacts on safety that any building work might have.

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